THE IMPACT OF ENVIRONMENTAL RECALL AND CARBON TAXATION ON THE CARBON FOOTPRINT OF SUPERMARKET SHOPPING[1]

Luca Panzone[a], Alistair Ulph[b], Daniel John Zizzo[c], Denis Hilton[d], Adrian Clear[e]

[a]School of Agriculture, Food, and Rural Development, and BENC, Newcastle University;

[b]Economics, and Sustainable Consumption Institute, Manchester University;

[c]Newcastle University Business School, and BENC, Newcastle University;

[d]University of Toulouse;

[e]Department of Computer and Information Sciences, Northumbria University.

Abstract

This study uses an incentive-compatible experimental online supermarket to assess whether prior environmentally-friendly behaviour outside the store and carbon taxes motivate sustainable consumption. Previous research suggests that past decisions may influence current decisions because consumers compensate morally desirable and undesirable acts over time, and carbon taxes have been promoted as effective tools to reduce the carbon footprint of food baskets. After controlling for past consumption, results show that being required to recall past environmentally-friendly behaviour before shopping led consumers to purchase more sustainable food baskets. Carbon taxation also strongly reduces the carbon footprint of food baskets, showing no interaction with the task of recalling past behaviours.

Keywords: sustainable consumption; carbon footprint; food retailing; carbon tax; priming.

JEL Classification Codes: C91, D03, D12, Q01, Q58.

[1] This project was funded by the Newcastle University Institute of Research for Sustainability and by the EPSRC Digital Economy Research Centre (award EP/M023001/1). We are indebted to: Steve Hall for programming the website; Jia Liu for the recruitment of participants, and for lab management; John Kazer from the Carbon Trust for support in the estimation of carbon savings; and Anastasia Logan, Beth Gillard, Natasha Auch, Jorge Altamirano and Erika Amaral for research assistance. We thank three reviewers, participants to presentations at the Manchester Environmental Economics Workshop at the University of Manchester, the EAERE 2017 conference in Athens, and the AFE 2017 conference at the University of Chicago for useful feedback. The usual disclaimer applies. The experimental instructions can be found in online appendix 1.

1. INTRODUCTION

We use a novel incentive-compatible experimental design involving an online supermarket to study interventions designed to reduce the carbon footprint of actual food choices. Our research is motivated by current concerns over the sustainability of current food consumption (e.g. Garnett 2011; Grunert, Hieke, and Wills 2014; McMichael et al. 2007). Carbon emissions from food choices are estimated to account for around 30% of total household greenhouse gas emission in developed economies, with supermarkets capturing a large share of food expenditures (e.g., Panzone, Wossink, and Southerton 2013). As a result, there is increasing recognition that an effective sustainability policy requires the direct involvement of consumers (Dietz et al. 2009; Vandenbergh and Steinemann 2007), and that differing consumer choices in-store can lead to significant reductions in the carbon footprint of food baskets (Panzone et al. 2016). However, research on actual sustainable behaviour in supermarkets is limited, both in terms of assessing the sustainability of current food choices, and of designing persuasive instruments to motivate sustainable consumption. Our paper addresses this by testing whether the recall of past environmentally-friendly behaviour, and the use of a carbon tax are effective in reducing the carbon footprint of supermarket food shopping. To ensure incentive compatibility, consumers made real choices and actually received the goods they purchased.

Food choices are driven by a number of interconnected factors, such as price, taste, healthiness, and environmental impact (see, for instance, Dubois, Griffith, and Nevo 2014; Hoppert et al. 2012; Raghunathan, Walker Naylor, and Hoyer 2006). While preferences for all these attributes contribute to the decisions consumers make, the focus of this article is on the environmental impact of food choices, measured as their carbon footprint. Environmental preservation, for instance in the form of low-carbon food baskets, is a public good (Daube and Ulph 2016): the damage caused to the environment by a consumer purchasing high-carbon foods affects him as well as other consumers who buy low-carbon options instead. The pursuit of a low-carbon diet may then require consumers to give up personal benefits (in the case of food choices, e.g., accept a less desired flavour, or pay a higher price) to the advantage of social benefits (higher environmental quality). This propensity to prioritise social over private outcomes correlates with an individual's engagement in activities that protect the environment (Jia et al. 2017), and green consumerism is generally considered an ethical way of shopping (Mazar and Zhong 2010). Food consumption is also recurrent, so that consumers are called upon to manifest their morality repeatedly (e.g., in a weekly shopping trip): choices carrying environmental implications can be made within the same consumption episode (e.g. an initial

choice between high-carbon meat or low-carbon meat substitutes, followed by the choice between organic or standard vegetables), as well as across episodes (e.g. purchasing high-carbon meat again this week, after having purchased it last week). This time dimension makes habitual consumption a relevant barrier to behaviour change (Warde 2014), as some products may be purchased routinely, without paying attention to their impact on the environment. Finally, over time food choices may be influenced by behaviour in other consumption domains (e.g. purchasing low-carbon food in a supermarket after having saved water in the past week).

We experimentally investigate strategies that can encourage environmentally responsible behaviour in a simulated on-line supermarket[2]. Focusing on the carbon footprint of the basket as the behavioural variable, our first manipulation is a nudge that tests whether reminding consumers of their recent pro-environmental behaviour motivates subsequent sustainable consumption. This manipulation also allows testing whether pro-environmental behaviour in another domain acts as a complement (they co-occur) or a substitute (one comes at the expense of the other) for sustainable consumption in supermarket shopping (e.g. Greenberg 2014; Nauges and Wheeler 2017). The study of pro-environmental behaviour in a single domain implicitly assumes that one observation of pro-environmental behaviour is sufficient to characterise the environmental preferences of an agent, because underlying preferences are stable and cognitive dissonance processes (Festinger 1962) act to make behaviours consistent with underlying psychological states. For example, cognitive dissonance can explain compensatory behaviours in cases where individuals go into "moral debit" following an antisocial act, and react by doing something desirable: for instance, an initial attitude-behaviour inconsistency (e.g., overconsuming water despite caring for its conservation in Dickerson et al. 1992) may lead people to restore the positive link between environmental attitudes and behaviour (e.g. by shortening their shower) when this inconsistency is made salient. However, this personological model of morality fails to explain why over time individuals may alternate moral and immoral behaviours (Effron and Conway 2015; Gino, Norton, and Weber 2016; Khan and Dhar 2006; Mazar and Zhong 2010; Miller and Effron 2010). In particular, this approach does not explain instances of moral licensing where "desirable" (e.g. pro-social) acts motivate subsequent "undesirable" acts (Khan and Dhar 2006; Mazar and Zhong 2010): for example, a consumer may feel justified in buying a high-carbon meat product after purchasing organic fruit.

[2] The store is similar to Demarque et al. (2015), who studied the impact of normative reference points on the purchase of eco-labelled products.

To allow for a more general representation of moral behaviour, Monin and Jordan (2009) present a dynamic model of self-regulation where morality is driven by the moral self-image of the agent: individuals use past moral behaviour to remove the concern of appearing uncaring in subsequent moral tasks (moral licensing, e.g. Mazar and Zhong 2010; Mullen and Monin 2016); while past immoral behaviour motivates individuals to make reparations in present choices (moral cleansing, e.g. Sachdeva, Iliev, and Medin 2009). This approach views individuals as targeting a certain level of moral self-regard that they aim to achieve and maintain. In this view, when facing a moral dilemma individuals will engage in moral behaviour whenever the perceived moral self-worth accumulated through past choices is below a desired level; and may behave immorally when the perceived moral self-worth is above the desired level. To this extent, moral licensing or cleansing are special instances of self-regulation strategies that balance socially desirable and undesirable behaviours and are likely to occur to consumers experiencing conflicting consumption goals, e.g. hedonic pleasure and eating healthily (see, for instance, Dhar and Simonson 1999; Fishbach and Dhar 2005; Laran and Janiszewski 2009; Mukhopadhyay, Sengupta, and Ramanathan 2008). However, few studies have focused on pro-social goals, and these have produced evidence consistent with both moral licensing (Tiefenbeck et al. 2013) as well as consistency (Greenberg 2014) across consumption domains.

The second manipulation explores the role of carbon taxation to drive sustainable low-carbon behaviour in supermarkets. Carbon taxes are often considered a key instrument to reduce global warming by increasing the cost of consumption-related greenhouse gas emissions (Boardman 2008; Metcalf and Weisbach 2009; Pearce 1991). Previous work on carbon taxes indicates they potentially reduce total household emissions by up to 80% (Metcalf and Weisbach 2009), particularly by reducing energy consumption (Brännlund and Nordström 2004). In the particular context of food policy, interventions have focused on nutrient-based taxes, targeting alcohol (Panzone 2012), sugar (Zizzo et al. 2016), or fat content (Papoutsi et al. 2015). A carbon tax mirrors nutrient-based interventions by taxing a constituent of food products with environmental instead of health implications. However, there is limited research on their impact on consumption (e.g. Briggs et al. 2016). Because green taxes are designed primarily to reduce externalities rather than raise revenues (Metcalf and Weisbach 2009; Pearce 1991), the carbon tax in the experiment is designed to ensure revenue-neutrality by returning earnings to consumers as income. Note that the carbon tax was announced to consumers, thus

potentially sending a signal about the environmental quality of each product (Hilton et al. 2014).

We also test for the interaction of taxes and environmental recall, because we may expect price interventions to influence pro-environmental motivation (see Bowles and Polania-Reyes 2012; Rode, Gómez-Baggethun, and Krause 2015). Taxes can motivate consumers by signalling the importance of sustainability in the mind of the policymaker; or demotivate them by removing the ability to self-signal interest in pro-social behaviour (Bowles and Polania-Reyes 2012; Gneezy, Meier, and Rey-Biel 2011). Testing this proposition specifically on grocery, Perino, Panzone, and Swanson (2014) show that subsidising sustainable products can indeed reduce their consumption.

The rest of the article is as follows. The next section discusses the simple model of moral self-regulation used to describe the consumer decision problem. This section also explains how the experimental treatments can be used to increase consistency in the purchase of low-carbon baskets. Section 3 describes the data collection method, which measures consumer supermarket behaviour and attitudes and beliefs concerning the environment over a two-week period as well as out-of-store pro-environmental behaviour between the two shopping occasions. Section 4 presents the results of the econometric analysis. Results indicate that both taxes and the requirement to recall previous environmental behaviours strongly influence behaviour with similar strength such that the behavioural intervention would have the same impact as a £70/tonne CO_2e carbon tax. Section 5 discusses the implications of these results for policy and future research. Finally, Section 6 briefly concludes.

2. MORAL SELF-REGULATION, ENVIRONMENTAL TAXATION, AND CONSUMER BEHAVIOUR

This section sets out a simple model of consumer behaviour when individuals care about both the direct hedonic pleasure and the environmental impact of the goods they buy. The section will then contextualise the theoretical implications of the experimental manipulations, also identifying testable hypotheses in an econometric model of demand for carbon emissions.

2.1. A model of moral consumer behaviour

Consider a consumer i with characteristics D_i. Following Dubois et al. (2014), during a weekly shop for food, the consumer is faced with a choice of $j = 1,\ldots, J$ products of K characteristics, specifically their carbon footprint c_j, kilocalories $z_{j,}$, and other observable characteristics, e.g. packaging (omitted for simplicity). Goods are sold with market prices $p_{j.}$, $j = 1,\ldots,J$. The consumer faces a budget constraint E, so that

$$\sum_j x_{ij}p_j + w_i p_0 = Y_i + w_i = E_i \quad (1)$$

where Y_i are in-store expenditures, w_i is the outside good (savings, in the experiment below), which for simplicity has a unit price ($p_0 = 1$), and x_{ij} is the quantity of good j purchased. In the experiment below, the expenditure limit E is the same for every consumer, but we leave the suffix i to retain generality. Apart from the direct utility the consumer derives from consuming x_{ij}, the consumer gains utility from: a) the morality of consumption, which we contextualise as the environmental impact of a good (e.g. Cornelissen et al. 2008; Mazar and Zhong 2010), and is therefore negatively related to the carbon footprint c_j; and b) the healthiness of consumption, whose impact is negatively related to the indicator variable z_j. Notably, the characteristics c_j and z_j measure the damage to the environment and health respectively caused by the consumption of one unit of good j.

Similar to a bank account, the consumer can earn moral (environmental) credits by engaging in activities that protect the (environmental) public good, and consume them in activities that damage it. The flow of environmental and health benefits the consumer derives from consumption are defined as

$$m_i = m_{0i} - \sum_j x_{ij}c_j = m_{0i} - C_i \quad (2)$$

$$h_i = h_{0i} - \sum_j x_{ij}z_j = h_{0i} - Z_i \quad (3)$$

where m_{0i} and h_{0i} are the credits earned in all other activities, while $C_i = \sum_j x_{ij}c_j$ and $Z_i = \sum_j x_{ij}z_j$ refer to the total amount of characteristic consumed. Equation (2) indicates that an individual i's self-worth corresponds to the moral credits earned in all other areas of behaviour, m_{0i}, minus the credits lost by the carbon footprint C_i of the individual's consumption choices. Equation (3) replicates this process for health considerations. Health decisions could also give moral credits that would enter equation (2); for instance, a consumer may believe that foods high in kilocalories are morally undesirable because obesity causes an unnecessary economic

burden on public healthcare[3]. However, in what follows m_i captures the rather narrow focus of environmental credits, measured as the carbon footprint of the good. As such, the impact of kilocalories on the environment is indirect and driven by the emission of those CO_2e required to produce the food and the energy it provides[4], and their impact already enters equation (2). Therefore, we assume the impact of kilocalories has individual specific effects which can be self-regulated in terms of health credits as measured by equation (3) (see e.g., Chernev 2011), and we do not discuss equation (3) further.

In a basket formation task, the objective of the consumer is to determine the quantity of each product *j* to purchase, x_{ij}, by maximising the utility function (Dubois et al. 2014; Hanemann 1984; Manchanda, Ansari, and Gupta 1999; Nair, Dubé, and Chintagunta 2005)

$$\max_{w_i, x_{ij}} U_i\left(x_{i1}, x_{i2}, \ldots, x_{iJ}, m_i, h_i, w_i\right)$$

subject to the usual budget constraint (1), as well as the moral and health constraints (2) and (3). Assuming quantities are continuous, the resulting first-order condition is

$$\frac{\partial U_i}{\partial x_{ij}} - \frac{\partial U_i}{\partial m_i} c_j - \frac{\partial U_i}{\partial h_i} z_j - \frac{\partial U_i}{\partial w_i} p_j = 0$$

The resulting demand functions for individual *i* are:

$$x_{ij} = d_{ij}(p_1, .., p_J, E_i, m_i, h_i) \quad (4a)$$

for *j = 1, ..., J*, from which consumer *j's* resulting carbon footprint is:

$$C_i(p_1, ..., p_J, E_i, m_i, h_i) = \sum_j c_i x_{ij} = \sum_j c_j d_{ij}(.) \quad (4b)$$

Assuming separability of the utility function to eliminate cross-price effects, the utility function can be written as

$$U_i(x_i, m_i, h_i, w_i) = \sum_j U_{ij}\left(x_{ij}\right) + \omega_m U_{im}(m_i) + \omega_h U_{ih}(h_i) + w_i \quad (5)$$

where ω_m (ω_h) is the weight the individual gives to well-being from moral self-worth (health) relative to the direct utility from the consumption of the goods, which is expected to be influenced by shocks to moral self-worth. This approach assumes full separability of any

[3] We thank an anonymous reviewer for highlighting this point.
[4] Notably, the Spearman correlation between carbon footprint and the energy content of the 620 foods in the store is $\rho = 0.53$ ($p < 0.001$).

consumption outside the experimental design to the extent that consumers are expected to obtain the same utility from items consumed in the experimental store as well as outside of it.

This model is one in which the individual cares about her *flow* of moral self-worth. Ulph, Panzone, and Hilton (2018) generalise this to a multi-period model in which the individual also cares about her *stock* of moral self-worth (Bénabou and Tirole 2011; Mullen and Monin 2016; Zhong, Liljenquist, and Cain 2009). For the purposes of the empirical research, the model set out above is dynamic only in the sense that it allows us to capture the effect of a prior change to the individual's flow of moral self-worth m_{0i} as we explain below.

2.2. Keeping up with the past: Environmental recall as a nudge

A first treatment gives an unexpected exogenous shock of size θ_i to the individual's flow of moral self-worth m_i, prior to entering the store. The flow of moral self-worth changes as

$$m_i = m_{0i} - C_i + \theta_i \qquad (6)$$

This shock can, in theory, be positive or negative. However, this section focuses on a positive and exogenous shock, which is the case in our experiment[5]. Then the parameter θ_i gives a temporary boost to moral self-worth, which can be seen as a windfall in moral credits that the individual suddenly finds in her initial moral credits account, now equal to $m_{0i} + \theta_i$. From equation (5), there are two possible effects of this shock. The first, direct, effect is through $U_{im}(m_i)$: the increase in the flow of moral self-worth *licences* the consumer to reduce the amount of effort allocated to current moral consumption because of diminishing marginal utility (moral licensing, see Khan and Dhar 2006). This direct effect is then expected to increase the carbon footprint of a basket in response to an exogenous increase in the flow of moral self-worth[6]. A second, indirect effect is through ω_m: the shock could self-signal personal commitment to the moral goal (Baca-Motes et al. 2013; Fishbach and Dhar 2005; Gneezy et al. 2012), therefore increasing the weight the consumer assigns to the moral component of the

[5] The decision to focus on a positive shock was taken on the basis of the existing literature. As described in Mullen and Monin (2016), the experimental design needs a "no-shock" baseline to identify the effects of either (or both) a positive or negative shock treatment. Because our sample was limited, to ensure sufficient statistical power we had to choose between either a positive or a negative shock. The meta-analysis of Blanken, van de Ven, and Zeelenberg (2015) finds that the size of moral licensing experiments does not differ significantly when the baseline is a negative or a no-shock treatment, suggesting a negative shock is often not different from the control group, therefore supporting the notion that the impact may be asymmetric. However, this is not the primary aim of this work and we leave this as an avenue for further research.

[6] A negative initial shock would instead result in moral cleansing (Sachdeva et al. 2009), with a subsequent reduction in the carbon footprint of the basket.

utility function. In other words, the shock may prime greater goal striving (pro-social priming or framing effects have been for instance observed in Cookson 2000; Elliott, Hayward, and Canon 1998; Liberman, Samuels, and Ross 2004). Notably, this second effect may operate sub-consciously, i.e., through automatic cognition, as well as consciously (see, for instance, Gino et al. 2016). The effect has the opposite direction of the licensing effect, and reduces the carbon footprint of the basket. This leads to a first set of hypotheses:

H_{1a}: An exogenous shock to environmental self-worth increases the carbon footprint of an individual's shopping basket (licensing effect) if it primarily increases the flow of environmental self-worth of the consumer.

H_{1b}: An exogenous shock to environmental self-worth reduces the carbon footprint of a shopping basket (consistency effect) if it primarily primes an increase in the weight given to the moral characteristic during the decision task.

2.3. Raising the costs of carbon: Carbon taxation as a tool for reducing the consumption of carbon emissions

Carbon taxes are often advocated as an option to reduce the carbon footprint of baskets by incorporating the external costs of carbon footprint into the price of the good. The role of price instruments in changing behaviour is based on the general premise that price changes force consumers to reallocate their budget from the now relatively more expensive (e.g. taxed) options to cheaper ones. Specifically, the tax treatment increases the marginal price of the carbon footprint by a value *T* equal to the rate of the tax per unit of carbon footprint, so that the price of all goods is increased from p_j to $p_j + \tau_j$, where $\tau_j = Tc_j$. Notably, taxation inevitably induces both price effects, whereby consumers shift to low CO_2 equivalent (CO_2e) products[7], which are now relatively cheaper because of a lower tax; as well as income effects, as consumers buy less because the tax reduces their disposable income. A redistribution mechanism embedded into the treatment aims to remove income effects by returning total revenues from the tax, $\sum_j \sum_i \tau_{ij}$, in equal shares to all consumers who paid the tax. In addition, our combined tax and redistribution manipulation mirrors the fact that green (Pigouvian) taxes

[7] In the remainder of the article, the carbon footprint will be reported in terms of carbon dioxide equivalent (CO_2e). Specifically, the carbon footprint consists of carbon dioxide (CO_2) as well as other gases that affect the atmosphere (CFCs and methane, for instance); the carbon footprint converts the damage caused by these gases into the amount of CO_2 needed to cause the same damage, and adds all the gases into a single metric, known as CO_2e. gCO_2e stands for grams of carbon dioxide equivalent.

are normally designed to induce changes in behaviour that benefit the environment, not to raise additional revenue for the government, and are designed to be revenue-neutral.

Apart from a standard direct effect, where the tax reduces consumption by raising market prices, the tax can also have an indirect behavioural effect: the mere presence of a tax can have psychological effects that either reinforce or diminish the pure economic effect of this policy instrument (see e.g. Sunstein and Reisch 2014). For instance, awareness of the tax might trigger psychological tax aversion (Sussman and Olivola 2011), psychological reactance (Lamberton 2013), or signal that the subsidised product is of inferior quality (given the relationship between price and expected quality, see Kirmani and Rao 2000). Any one of these responses would lead to an additional purely behavioural response that undermines the direct price effect on the consumption of undesirable (and taxed) goods (e.g. Zizzo et al. 2016). At the same time, the presence of a regulation like a tax may signal to consumers that certain products are "good" and others are "bad" for society from the perspective of the policymaker who introduced it, activating social preferences that lead to a stronger effect than that of the price change alone (Bowles and Polania-Reyes 2012). Carbon taxes may also serve an informational function, like eco-labels, by helping consumers identify high- and low-carbon choices. However, in this article we do not seek to isolate pure price effects from pure behavioural effects of carbon taxation, although the two sets of effects are likely to occur in parallel in practical policy applications. The second working hypothesis is that

H_2: A revenue-neutral carbon tax will reduce the average carbon footprint of baskets by increasing the marginal price of carbon footprint in the basket.

2.4. The interaction between carbon taxation and environmental recall

A consumer's response to carbon taxation may depend on the amount of environmental self-worth the individual holds. For example, the imposition of a carbon tax may remove the priming effect of the self-worth shock, with the result that the self-worth shock is only effective in the absence of a tax; indeed, in the presence of a tax consumers may no longer attribute the cause of a low-carbon basket to their pro-social preferences, but to a desire to minimise the tax paid[8] (e.g. Perino et al. 2014; Zuckerman, Iazzaro, and Waldgeir 1979). Then, the shock would only operate through $U_{im}(m_i)$, causing an increase in the carbon content of the basket. A

[8] A similar mechanism also occurs in the forced-constraint treatments of dissonance experiments, see discussion in Hilton et al. (2014).

negative (carbon-reducing) interaction term could instead result if the priming effect caused by the shock increases the effectiveness to the tax, for instance because the consumer perceives the pro-social objective of a new regulation (Bowles and Polania-Reyes 2012; Gneezy et al. 2011). Specifically, by increasing m_i, the shock θ_i increases the weight given to the a low-carbon basket, $\omega_m(m_i)$, increasing the value a consumer places on environmental preservation; in turn, this higher value results in an increase in the effort placed on the construction of a low-carbon basket. Then, the third testable hypothesis is:

H_3: The shock to the moral self-worth and the carbon tax may interact; the sign of this interaction will depend on whether the tax removes the priming effect of the shock (a negative effect), or if it increases it (a positive effect).

2.5. Estimation

The utility maximisation process identifies the optimal consumption of carbon footprint in the basket, C_i, as from equation (4b). This carbon footprint depends on: a vector of individual characteristics D_i, measured in week 2; the carbon footprint purchased in the previous week C_{1i}; the carbon footprint saved by engaging in environmentally-friendly behaviours in the past week, m_{0i}; and the experimental stimuli $I_i \equiv [\theta_i, T_i, T_i\theta_i]$, where θ and T refer, respectively, to the environmental recall and the carbon tax. The demand for carbon emissions in week 2 is then specified using the log-linear regression

$$ln(C_{2i}) = \alpha_0 + \alpha_1 m_{0i} + \alpha_2\, C_{1i} + \alpha_3\, D_{2i} + \gamma I_i + \varepsilon_{2i} \qquad (7)$$

where $\gamma \equiv [\gamma_\theta, \gamma_T, \gamma_{T\theta}]$. The hypotheses above entail the following results: a licensing effect (H_{1a}) implies $\gamma_\theta > 0$; a consistency effect (H_{1b}) implies $\gamma_\theta < 0$; a successful carbon tax (H_2) would require $\gamma_T < 0$; if the tax removes the priming effect of the shock, $\gamma_{T\theta} < 0$, while if the tax increases it, then $\gamma_{T\theta} > 0$.

In equation (7), current consumption C_{2i}, past behaviours C_{1i}, and carbon saved m_{0i} are simultaneously determined: they may depend on the same motivational drivers, and are connected by the use of a single metric that identifies the social impact of these behaviours. In fact, past behaviours in and out of the store may have been influenced by expectations over future behaviours (Cascio and Plant 2015; Khan and Dhar 2007), and past outcomes in turn influence present behaviour (Browning and Collado 2007; Khan and Dhar 2006). As a result, consumers may decide on the amount they can consume in the second week on the basis of the

carbon allowance earned by engaging in past sustainable behaviour, as well as the amount of carbon consumed in the shop previously. Thus, consumers are expected to engage in a mental accounting exercise (see e.g., Milkman and Beshears 2009), where carbon emissions are split into different interconnected areas of consumption. To consistently estimate equation (7), carbon purchased in week 1 and saved between the periods are modelled as a function of past mental states as

$$ln(m_{0i}) = \beta_0 + \beta_1 C_{1i} + \beta_2 D_{1i} + u_{2i} \quad (8)$$

$$ln(C_{1i}) = \pi_0 + \pi_1 D_{1i} + \varepsilon_{1i} \quad (9)$$

Equations (7)-(9) are a triangular system of simultaneous equations[9] (Imbens and Newey 2009; Lahiri and Schmidt 1978), which is estimated using a recursive seemingly unrelated regression (SUR) that allows for unobservable preferences connecting the three decisions. Consistent standard errors are obtained from bootstrapping (see e.g., Prucha 1987).

3. DATA AND EXPERIMENTAL DESIGN

A total of 260 students were recruited to participate in an online shopping experiment. They were paid a £5 fee purely for their time, and were assigned a £25 weekly budget to shop in the store once a week for two consecutive weeks. The online shop presented consumers with 620 food and (non-alcoholic) drink products currently available in Tesco stores (Figure 1). Key criteria for inclusion of products in the store was the availability of an actual full (pre-discount) price in Tesco stores, carbon footprint (in CO_2e), and nutritional facts (kilocalories, and grams of selected macronutrients) for each item. The store uses existing products from Tesco[10], which have actual carbon footprint measures from a single source and for a wide range of products, covering all the categories of interest of the study sample[11]. Consumers could access the carbon footprint and nutritional composition of each product by moving a cursor onto a specific icon[12] (Figure 1). Moreover, as Figure 1 shows, the carbon and nutritional content of the basket was

[9] Note that Bajari et al. (2012) deal with a system of equations like (7) and (8) by differencing, which results in the main equation regressing present consumption on present and past psychometric variables. The small sample in our data exposes the results to multicollinearity, which increases the probability failing to reject a false null hypothesis (type II error). At the same time, for identification purposes Bajari et al.'s requires the imposition of equality of coefficients over time, a restriction that we do not apply here. Nevertheless, the results using this alternative specification lead to similar results on the treatment effects (results are available upon request).
[10] The dataset initially consisted of the products in the list available at https://www.tescoplc.com/assets/files/cms/Tesco_Product_Carbon_Footprints_Summary(1).pdf. Tesco kindly provided further information on products that were footprinted after this document was published online.
[11] A pre-survey and a survey pilot identified which products the target population purchased more frequently.
[12] The time the cursor spent on the icon was recorded.

always accessible next to the total bill, constantly updating as consumers added or removed products, providing real-time information.

Participants were informed at the start that they could spend as much as they wished in the store, and any unspent budget was then added to their participation fee and given to them at the end of the experiment. Collection worked as a "click-and-collect" scheme: participants would come and collect their baskets and their compensation the week after the end of the experiment. In the first week, participants shopped with no manipulation in place to provide a benchmark level of consumption; the manipulations were introduced in the second week. Participants were given the goods they had purchased in one of the two weeks of shopping, chosen randomly for each participant at the end of the experiment to ensure that both weeks were incentive-compatible shopping experiences. Of the 260 participants recruited, 235 participated in the first week of shopping, and 230 participants completed two weeks.

3.1. Experimental design

The core experimental design consisted of a 2 (environmental recall vs no environmental recall) x 2 (carbon tax vs no tax) orthogonal between-participants experimental design for 199 participants; in addition, an extra group was added to control for possible measurement effects, as explained below. The full experimental design is shown in Figure 2. For those participants asked to report their environmental self-image before shopping, in each experimental week the procedure consisted of the following tasks (in the exact order): they reported their perceived environmental self-image (see section 3.3); they shopped; and completed a questionnaire on their attitudes and beliefs on the importance of the environment[13] (see section 3.3). Socio-economic characteristics were only collected in week 1 at the end of the questionnaire. A fifth "Control group – Self-Image measured After" (henceforth, "Control – SI After") group (31 individuals) was included, for whom self-image was measured after shopping in both weeks: this group is identical to the "Control" group, apart from the position of the environmental self-image question, to test whether asking this question before shopping primed participants to buy a low-carbon basket. Week 2 was the same as week 1 for each treatment with the following two exceptions:

[13] Information on attitudes and beliefs on the importance of the environment were collected twice to monitor potential changes in the mindset of the consumer.

a. An *environmental recall manipulation* was implemented in the two treatments with environmental recall: consumers started by completing a questionnaire that asked them to report how frequently they had performed a number of pro-environmental behaviours in the previous week. The number of occurrences of a behaviour was multiplied by a conversion factor that measures the difference in CO_2e between the environmentally-friendlier and -unfriendlier behaviour, to obtain an estimate of carbon savings that were notified to participants (see section 3.1.1 for details). The list of behaviours and the conversion factors are reported in Table 1. Consumers answered the environmental self-image question after filling this questionnaire, and then shopped.
b. A *carbon tax manipulation* was implemented in the tax treatments: a carbon tax was introduced and changed food prices proportionally to the carbon content of a food product (all tax revenue was redistributed; see section 3.1.2 for details).

3.1.1. Environmental recall manipulation

The environmental recall treatment required consumers to indicate the frequency over the last seven days of a number of environmental behaviours shown in Table 1 below, using a questionnaire that requested:

> *"Please pause one moment and think about the activities you have done in the past week (i.e. in the past 7 days) to help protect the environment for you and for others. How often have you done any of these during the last week?*

Carbon savings were estimated for each of these behaviours on the basis of published data in order to determine the total amount of CO_2e saved by each participant during the seven days before the second week of shopping Straight after completing this questionnaire (therefore before entering the shop for the second week of shopping), participants were notified that

> *"CONGRATULATIONS! Over the last seven days you have saved [estimated CO_2e saved] grams of CO_2e".*

This message was delivered just before participants reported their environmental self-image. This approach allowed consumers to recall socially desirable acts they performed in the recent past, while quantifying the social benefits of such acts using a carbon footprint metric. Participants who were not in an environmental recall treatment filled the environmental recall

questionnaire at the end of the week 2 shopping and survey, and were not notified of their carbon savings.

3.1.2. Carbon tax manipulation

In the first week of the experiment, the prices of the goods reflected the exact prices consumers would find in Tesco stores (removing all discounts). These prices did not change in the second week for those participants in the "Control" and the "Environmental recall" treatment. In the second week, participants in both treatments with a carbon tax were presented with prices that reflected the carbon content of the products available in store. This carbon tax, measured as the CO_2e content of each product multiplied by a £70/tonne of CO_2e (in line with estimates from DECC 2016), was added to the baseline price, which on average raised food prices by 8.47%. To ensure the visibility of the carbon tax, consumers were presented with full prices (i.e. inclusive of the tax), with the addition of a line below the price indicating "This price includes £[value] of carbon tax" (see Figure 1 above). For the reasons discussed in section 2.3, total tax revenues were redistributed to participants in the treatments with a carbon tax, who were reimbursed by the average tax paid. Participants facing a carbon tax manipulation were notified of this redistribution before the shopping task, where the instructions read (full instructions can be found in the online appendix; emphasis is as presented to participants):

> ***The total revenues raised from the carbon tax (i.e. from all participants) will be shared equally between all taxpayers:*** *everyone in this treatment (including you) will receive back exactly the same amount of tax revenue at the end of the experiment.*

Rational consumers knowing the presence of a redistribution mechanism in advance would be expected to make decisions that reflect the fact that income effects would be neutralised. Importantly, note that payment was received at the end of the experiment, whether from the initial endowment or from the redistribution mechanism. We return to the issue of potential income effects in Sections 4.2 and 4.7.

3.2. Measuring the carbon footprint of baskets

As discussed in Section 1, sustainable consumption of the consumer in each weekly shopping episode is measured in terms of the carbon footprint of the basket in grams of CO_2e, to circumvent problems of aggregation of products that can differ noticeably in product quality.

Econometrically, this represents the consumer demand for carbon footprint. Similarly, as already noted above, the frequency of the behaviour from the environmental recall questionnaire reported in Table 1 was converted into grams of CO_2e saved in the previous week by engaging in the environmental activities. This meant that the amount of carbon savings based on the recalled behaviours was measured in the same metric as the environmental impact of the basket.

3.3. Measuring environmental identity, self-image, knowledge, and attitudes

The analysis below uses a number of constructs from the literature on moral and prosocial behaviour. The first item is an "environmental identity" scale, adapted from the moral identity scale of Aquino and Reed (2002). As expected, the principal component analysis yielded two factors (see online appendix 2): the *internalisation* component of identity, which measures how central environmental identity is to the self-concept of the consumer; and the *symbolisation* component, which measures how much the respondent believes his actions reflect this environmental identity. The variable used in the regression is the estimated Bartlett score. Following Jordan, Mullen, and Murnighan (2011), environmental self-image is measured as the answer to the question "Compared to the environmentally-friendly person I want to be, I am…"; the scale goes from 1 = "Much less environmentally friendly than the person I want to be" (insufficiently environmental self-image, and moral "debit"), to 9 = "Much more environmentally-friendly than the person I want to be" (excessively environmental self-image, and moral "credit"); the centre of the scale is 5 = "Exactly as environmentally friendly as the person I want to be" (no discrepancy in self-image). Knowledge of product carbon footprint was measured as the sum of correct answers to four questions asking participants to identify high carbon options within four pairs of goods present in the store (see the online appendix). Finally, following Cornelissen et al. (2008) pro-environmental attitudes refer to the answers to three questions: "How do you feel about environmental behaviours?", "How do you feel about performing environmental behaviours?", and "How important is it that you perform environmental behaviours?"; the responses to these three attitude questions, collected using three 7-point Likert scales (1=very negative, and 7=very positive), in the analyses that follow were summed into a single composite score.

4. RESULTS

This section presents evidence of the impact of the environmental recall requirement and carbon tax on consumer behaviour. Results indicate that a carbon tax reduces the carbon footprint of food baskets, with estimates that are robust to variable choice and model specification; the requirement to recall past environmental behaviours also leads to a reduction in carbon footprint, with estimates that are robust across regressions, although significance can change depending on the variables included. The two effects are similar in magnitudes: the environmental recall task produces reductions comparable to those of a £70/tonnes CO_2e tax. The two treatment manipulations do not interact significantly. In presenting these results, we begin by introducing the characteristics of the sample, with a particular focus on expenditures, carbon consumed and saved, and consumers' environmental self-image. These steps are then followed by a regression analysis to test the hypotheses discussed in Section 2.

4.1. Descriptive statistics

The experiment collected information on 199 participants allocated to the main experiment, plus 31 consumers in the "Control – SI After" where self-image was measured after shopping. Table 2 shows the demographic breakdown of all treatments, showing that, apart from the share of British nationals, groups did not differ significantly in their demographic composition. Similarly, the groups did not differ in their reported environmental self-image in both experimental weeks.

4.2. Consumer expenditures across weeks

We begin by analysing expenditures across treatment group. Table 3 shows that consumers spent non-significantly different amounts of money in all treatments in both weeks[14]; at the same time, in the second week expenditures dropped significantly in all groups except the "Control – SI After". This expenditure drop is particularly relevant for consumers facing a carbon tax: they could have been avoiding the taxed goods in the experimental store in order to buy them in a regular store afterwards by increasing savings, thus lowering the carbon footprint of the baskets without actually changing their overall consumption pattern. However,

[14] Notably, only one person in the "Control" condition spent nothing in the second week of shopping; while everyone bought something in the first week.

Table 3 shows that consumers in the tax treatment actually spent more than the control by (partially) saving less (by £0.30, relative to the "Control" condition). While the small samples imply the lack of a statistically significant difference, these descriptive statistics suggest that consumers in the tax treatment did not substitute to the outside good, a finding that is consistent with previous research that showed that consumer expenditures outside an experimental online store were not influenced by the decision made during the experiment[15] (Zizzo et al. 2016). We return to this point in section 4.7, where we analyse the allocation of budget to different expenditure classes across treatments.

4.3. The characteristics of the baskets across weeks

The change in expenditures across the different groups observed in the previous section resulted in a change in the composition of the baskets in each treatment. Table 4 indicates that basket carbon footprint dropped significantly in all treatments in the second week (except in the "Control" and the "Control – SI After" groups). This pattern is shown in Figure 3. The carbon footprint per £ spent also decreased in the presence of a tax, with the largest drop in total carbon footprint when the tax and the environmental recall treatment manipulations were jointly presented. These results suggest that the reduction in carbon footprint in the presence of a tax was not determined by consumers spending less on their basket, but by consumers purchasing less carbon footprint per GBP spent. At the same time, Table 4 shows that the amount of kilocalories purchased in the "Tax" condition followed similar time patterns as the Control" condition. This point presents further supports to the notion that consumers in the tax treatment did not drastically reduce their consumption needs because of the higher price: consumer needs (in terms of kilocalories needed) did not vary relative to the "Control" group. Notably, all experimental groups showed a decline in protein consumption; in addition, consumers facing a tax (alone or jointly with recall) purchased less salt, while the presence of an environmental recall questionnaire reduced the consumption of fats. Consumption of sugar was unaffected by the experimental manipulations. This nutritional profile (less protein, less fats, no sugar change) points to a reduction in the consumption of products of animal origin (fresh or in ready meals).

[15] It is worth noticing that while the store was similar, Zizzo et al. (2016) focussed only on two sets of products (soft drinks and breakfast cereals). However, the work is conceptually close, with consumers making multiple choices and being randomly selected to receive one directly home.

Finally, as expected, the consumption of carbon footprint is strongly correlated over supermarket visits, revealing a noticeable habitual component. The Spearman rank correlation between the carbon footprint of the baskets in the first and second weeks was $\rho = 0.83$ ($p < 0.001$) in the "Control treatment", 0.80 in the "Control – SI After" treatment, $\rho = 0.87$ ($p < 0.001$) in the "Tax" treatment, $\rho = 0.80$ ($p < 0.001$) in the "Environmental recall" treatment, and $\rho = 0.58$ ($p < 0.001$) in the "Tax + environmental recall" treatment. These values indicate that the joint presence of the recall questionnaire and the tax had the most disruptive effect on habits, as also reflected by a strong drop in carbon footprint.

4.4. Environmental self-image

A consumer's moral self-image is a theoretically important motivator of moral behaviour, because it enables a measure of the consumer's perceived distance from a desired level of morality[16] (Monin and Jordan 2009). As such, we would expect a positive correlation between environmental self-image and CO_2e consumption, *ceteris paribus*: holding the target moral stock constant, consumers who report doing less well than they wish with respect to the environment should build baskets with less CO_2e compared to those who report no discrepancy in self-image (moral cleansing effect); these in turn would be expected to put less carbon footprint in their basket compared to those who report doing better than they wish (moral licensing effect). To ensure the value only referred to the mental state of the consumer *prior to* any purchase, the self-image question was asked before the shopping trip, except for the additional "Control – SI After" condition[17].

Table 5 shows that environmental self-image is related to the symbolization (but not the internalisation) component of environmental identity (as in Jordan et al. 2011). However, the correlation between environmental self-image and the carbon footprint of the basket is weak: while the environmental self-image score of participants is as expected negatively correlated to the carbon footprint of a basket in all treatment groups (i.e., as self-image increases, the

[16] A test of internal validity shows that this metric is fairly stable across time period. In fact, the Spearman rank correlations across treatments are as follows: "Control" = 0.7295, p = 0.000; "Environmental Recall" = 0.5859 (p = 0.000); "Tax" = 0.7306 (p = 0.000); "Tax + Environmental Recall" = 0.3069 (p = 0.032).

[17] The position of the environmental self-image question influenced the response given: participants who answered this question after shopping (the "Control – SI After" treatment) reported a lower self-image compared to the rest of the sample in week 1 ($p < 0.05$ if tested against all treatments; $p < 0.10$ if tested against the "Control" treatment only), suggesting that the act of shopping in itself made people feel relatively environmentally-unfriendly; the effect is not present in week 2 ($p > 0.10$ when tested against all treatments, as well as when tested against "Control" treatment only).

carbon footprint of the baskets decreases), these relationships are significant only in week 2 for participants in the "Environmental recall" and "Control" treatments, and in an overall analysis of the whole sample[18]. As a result, the consumer's environmental self-image does not appear to be a strong motivator of the construction of low-carbon baskets (however, note that this relationship is correlational rather than causal), and other aspects of the psychological profile of consumers may play a more dominant role. Importantly, Figure 4 shows that the presence of the environmental self-image question before the shopping trip did not prime participants: those who answered the environmental self-image question before shopping bought a non-significantly higher (rather than lower) carbon footprint in their basket in both weeks. Finally, a median test reveals that the median drop in basket carbon footprint in the "Control – SI After" group is not different from the "Control" group ($p = 0.548$).

4.5. Estimated carbon savings from the environmental recall questionnaire

All participants filled the environmental recall questionnaire (see Table 1). Importantly, only participants in the environmental recall group filled this questionnaire just after logging into the online shop: these participants actually knew their estimated carbon savings before shopping in the second week. These scores were calculated by deriving an overall estimate of the carbon footprint consumers reported saving in the past week by engaging in environmentally-friendly behaviours. In the sample, no participant reported zero carbon savings (mean = 13,034 gCO2e, median = 12,202 gCO2e), with no differences in the distributions across experimental treatments[19]. The amount of recalled carbon savings in the previous week may be expected to be positively related to the environmental self-image score of the consumer, as a person with large savings is more likely to believe she has done enough (or more than enough) for the environment; however, a non-parametric local polynomial regression (Fan and Gijbels 1996) shows that the relationship between these metrics is fairly flat (Figure 5), with a non-significant Spearman correlation (Table 5). Similarly, the estimated amount of carbon savings outside the store in the previous week and carbon purchased inside the store in week 2 do not appear to complement or substitute each other: the Spearman

[18] The whole sample in this case includes participants in all 5 treatments. The correlation coefficient of the "All sample" column in Table 4 remains significant if the two controls are removed, either individually or jointly.

[19] A two-sample Kolmogorov-Smirnov test indicates that, relative to the "Control" treatment, treatments do not have significantly different distributions: "Tax" treatment ($D = 0.1376$, p-value = 0.665); "Environmental recall" treatment ($D = 0.1581$, p-value = 0.48); "Tax + environmental recall" treatment ($D = 0.0816$, p-value = 0.99). Median carbon savings did not differ across these treatments (median test, $\chi^2(3) = 2.3697$, $p = 0.50$).

correlation coefficients are not significantly different from zero ("Control": $\rho = 0.12$, p = 0.40; "Environmental recall": $\rho = 0.15$, p = 0.30; "Tax": $\rho = -0.18$, p = 0.20; "Tax + Environmental recall": $\rho = -0.05$, p = 0.72). Together, these results indicate that the carbon footprint of the present sample of consumers was not linked across the different domains (as would be the case under mental accounting, see the literature cited by Milkman and Beshears 2009), and participants did not use their self-reports of the activities in Table 1 to determine their environmental self-image.

4.6. Environmental recall, carbon taxation, and the carbon footprint of food baskets

The aim of this section is to estimate equation (7), testing the experimental hypotheses concerning the impact of the requirement to recall environmental behaviours and carbon taxation on the carbon footprints of food baskets. Covariates are added progressively to the regressions: a first regression adjusts for treatment dummies only, and is estimated using a OLS regression (model A); a second regression adds the CO_2e of the basket in the previous week to equations (7) and (8) only, estimating a two-equation system (model B); a third regression adds demographics (gender, age, British nationality) to all equations, and carbon saved to equation (7) (model C); a fourth regression adds psychological variables (identity scales, and environmental attitudes), day of shopping trip, and, for in-store equations, knowledge of product carbon footprint (model D); and a fifth regression adds the logarithm of total expenditures to in-store equations (7) and (9) (model E). In these regressions, the environmental recall dummy includes all participants in the two treatments with an environmental recall questionnaire; the tax dummy includes all participants in the two treatments with a carbon tax; while the multiplicative interaction term identifies the joint treatment manipulations effect. Because the interaction term is not significantly different from zero, it is dropped from the main equation, because its presence increases the standard errors of the treatment variables due to multicollinearity (these results, which do not significantly affect the estimated coefficients, are found in appendix 2).

A first set of regressions (the first five columns of Table 6) uses the natural logarithm of the carbon footprint in the second week of shopping as dependent variable. However, while some participants might have spent a significant amount of money on price premia to have a full basket with low-carbon options, others might have obtained a low-carbon basket by spending little money. To address the problem, a second set of regressions (the last five

columns of Table 6) normalises the carbon footprint by the amount of money spent, using as dependent variable the logarithm of the ratio C_i/Y_i. Both these transformations lose one participant who did not buy anything in week 2. Finally, in both equations all continuous variables appear in logarithmic form. The coefficients of these regressions, which follow equation (7), measure the marginal log-impact of the policy (the half-elasticity). The marginal impact of the experimental manipulation on each consumer in gCO_2e can be obtained from the estimated coefficients as: $\frac{\partial C}{\partial I} = \gamma C_i$ for the equation using the logarithm of carbon footprint as the dependent variable; and $\frac{\partial C}{\partial I} = \gamma C_i Y_i$ for the regression where the carbon footprint of the basket is normalised by income.

Table 6 presents the estimated coefficients from equation 7, which tests the impact of the experimental conditions on the carbon footprint of the basket in week 2. These results indicate that the presence of an environmental recall questionnaire before the shopping task drives a reduction in carbon footprint, providing no evidence of a licensing effect, and instead supporting the existence of a consistency effect (in support of H_{1b} rather than H_{1a}). Similarly, a carbon tax significantly reduces the carbon footprint of the basket[20], providing evidence in support of H_2. These two main effects are of comparable size. The joint effect is the sum of the two individual effects, with no significant interaction between them (see appendix 2): the results provide no evidence to support either H_{3a} or H_{3b}, but rather indicate that carbon taxation does not alter the environmental motivation of consumers. In terms of marginal effects (on the basis of SUR estimates only), carbon taxation reduces the carbon footprint of a food basket by 2.5-3.3 kg CO_2e, while environmental recall leads to a reduction of 2.4-3.1 kg CO_2e[21]. Assuming this shop was representative of an average weekly shop, the average reduction per household is 130-172 kg CO_2e/year for the carbon tax, and 125-161 kg CO_2e/year for the environmental recall questionnaire. To put these numbers into perspective, the carbon footprint of one litre of petrol is 3.15 kg CO_2e, and that of one low-energy lightbulb left on continuously for a year is 90 kg CO_2e (Berners-Lee 2011). Finally, the tax increased prices by 8.47% (on average), and reduced carbon emissions by 15-19%, raising £107.65[22]; these figures indicate a

[20] The only insignificant coefficient in these tables is slightly above the 10% probability (p=0.164)
[21] The average carbon footprint in the basket in the first week was 20,312 gCO_2e; the average carbon footprint in the "Control" group in week two was 19.9 $kgCO_2e$.
[22] The average tax paid by the 99 participants in the tax treatments was £1.09, or 6.8% of their £15.97 spend.

tax elasticity of demand for carbon footprint of -1.8 to -2.2, and a reduction of 23-31 gCO_2e/£ of tax earned.

Table 6 also shows that the carbon footprint purchased in week 1 is a strong predictor of the carbon footprint purchased in week 2, indicating a strong role of habits in the generation of carbon emissions from food purchasing. The estimated carbon savings before shopping are also positively related to the carbon footprint in the basket, with an elasticity of 0.07-0.2 that is not significant in any regression. Results further indicate that demographic and psychological profile variables have limited predictive power on the main equation: in the second week, gender is significant only when the regression is adjusted by expenditures, with male participants buying baskets with lower CO2e/£ than women; British consumers have baskets with more carbon footprint only before adjusting for attitudes and expenditures; while carbon footprint knowledge (see section 3.3) is significantly and positively related to the carbon footprint of a basket before adjusting for expenditures.

Tables 7 and 8 show that some personal characteristics also explain the estimated carbon savings in the seven days prior to the experimental week 2, as well as the carbon footprint of the basket in the first week. Particularly important is the internalisation component of the environmental identity (the centrality of environmental preservation is in the consumer's self-concept), which is positively associated to the estimated carbon savings, and negatively related to the carbon purchased in the first week (only before adjusting for expenditures): consumers who value more the protection of the environment reported larger carbon savings, and purchased lower-carbon baskets in the first week. The carbon footprint bought in-store in the first week did not influence the estimated amount of carbon saved between the two shopping trips (Table 7). Finally, a British nationality and strong pro-environmental attitudes (see section 3.3. for the exact questions) are associated to baskets with higher carbon footprint in the first week, but their impact disappears after adjusting for expenditures; and similar to week 2 gender is significant only when the regression is adjusted by expenditures, although with an opposite sign, so that male participants bought baskets with higher CO2e/£ than women (Table 8).

Overall, results support previous research using actual sales data, which found that socio-demographics and attitudes play a modest role in predicting sustainable behaviour in a retail environment[23] (Panzone et al. 2016): rather, in this exercise the key factors explaining basket

[23] Notably, Panzone et al. (2016) do find a non-significant role of gender on consumption. However, they use an indicator of sustainability derived from total expenditures in a category, and expenditures shares, while the present work analyses the determinants of carbon footprint purchased.

carbon footprints of the second week are past consumption, and experimental stimuli. Part of the limited significant effects is possibly due to the small sample in the analysis, which, in association with large unobservable heterogeneity in consumer preferences, gives large standard errors.

As a final robustness check, we re-ran all regressions excluding consumers who may have been constrained by the £25 budget in the tax treatment. The rationale for this additional test is that these consumers may have been prevented from purchasing as much as they would have done if the redistributed money was available during the shopping task; in other words, the tax reduced the actual purchasing power of their budget, which is effectively below the £25 of the "Control" group. Results from a series of bootstrapped (1,000 replications) Hausman tests comparing the coefficients of the regressions in Table 6 with those from identical regressions excluding 2 individuals in the tax treatment who spent £25 show that no coefficient in Table 6 changes at a level of significance below 19%. Therefore, we find no evidence of income effects operating through this channel in the tax treatments.

4.7. Analysis of substitution patterns across groups

The previous section observed that environmental recall and the carbon tax reduced the carbon footprint of food baskets, without however showing how consumers achieved these reductions. In this section, we study substitution patterns using an almost ideal demand system (Deaton and Muellbauer 1980; Dhar, Chavas, and Gould 2003). This model regresses the share of expenditure s_{ij} of consumer i in seven food categories j (drinks, meat, fruit and vegetables, cereals, other products of animal origin, other products of vegetable origin, ready meals[24]), plus the share allocated to savings over prices p_{ik} and consumer characteristics as

$$ln(s_{ij}) = \delta_{0j} + \delta_{1jk} \sum_k ln(p_{ik}) + \delta_{2j} D_i + \gamma_j I_i + \epsilon_{ij} \quad (10)$$

where $k = 1, \ldots, 8$. D_i includes the same variables as Table 6, replacing day of the week with inventory (i.e., sub-categories where stocks were low). Notably, equation (10) omits the total expenditure term, because the budget is constant in the experiment, and results only provide

[24] Categories are as follows: *Drinks* = Bottled Water, Fruit Juice, Soft Drinks, Tea and Coffee; *Meat* = Canned Meat, Chilled Cooked Meats, Frozen Meat, Meat; *Fruit and vegetables* = Fruit (fresh or dried), Vegetables (fresh, frozen or canned), Dried Pulses and Nuts; *Cereals* = Bread and Bakery, Breakfast Cereal, Pasta, Flour, Rice; *Other products of animal origin* = Dairy Products, Eggs, Fish, Canned Fish, Honey; *Other products of vegetable origin* = Margarine, Oils, Non-Dairy Milk, Sugar; *Ready meals* = Chilled Meals, Canned Soup, Crisps, Soups, Sweets, Tomato Ketchup, Salt.

uncompensated elasticities. In the savings equation, consumers are modelled as consuming one unit of savings, with price equal to $p_i = -ln(savings_i)$, where the negative sign ensures that demand is downward sloping[25]. The model enforces three restrictions: adding-up ($\sum_j \delta_{0j} = 1$, $\sum_j \delta_{2jk} = 0$, $\sum_j \delta_{2j} = 0$, and $\sum_j \gamma_j = 0$), homogeneity ($\sum_k \delta_{1jk} = 0$), and symmetry ($\delta_{1jk} = \delta_{1kj}$). $p_i = -ln(savings_i)$Finally, prices faced by individuals who did not make a purchase in a category equal the average price paid in that category by other participants in the same group and week. The model is estimated using a multivariate Tobit model, and to correct for the endogeneity of prices[26] (see e.g., Dhar et al. 2003), we use a limited-information (LIML) estimator that simultaneously regresses the demand system with 8 price equations, using lagged (week-1) prices as instruments.

The estimated median elasticities are presented in Table 9, jointly with a Kruskal-Wallis test of significance across group. Estimated coefficients are reported in table A3 in the appendix. Notably, elasticities are available only for consumers who made purchases in a category. A first finding is that elasticities are relatively high; the literature presents no benchmark for single shopping instances, but short-term elasticities are generally expected to be high. Results also show that consumers in the presence of a tax become less responsive to meat prices. Kruskal-Wallis tests indicate that consumers in experimental treatments bought less meat (in terms of expenditures, p = 0.0049, basket weight, p = 0.0028, and budget share p = 0.0459); this reduction might have made consumers more attached to any residual meat consumption, reducing their ability to respond to prices. Experimental manipulations also weakened the substitutability of fruit and vegetables with other products of animal origin and ready meals. Kruskal-Wallis tests indicate that this weaker substitution resulted in consumers purchasing more fruit and vegetables (in terms of basket weight only, p = 0.0704), and less ready meals (in terms of budget share, p = 0.0423). As a result, carbon reductions may have occurred firstly through a decline in spending, and secondly through a substitution of ready meals and other animal products with fruit and vegetables. Finally, the results indicate that consumers in the tax treatments did not substitute to the outside good more often than the consumers in the other treatments, providing further evidence against the existence of income effects in the tax treatment.

[25] Otherwise, the expenditure share would be positively associated to the value of the savings.
[26] A test for endogeneity using a control function approach shows that at least one price variable is endogenous.

5. DISCUSSION

This article explored the impact of recalling previous environmentally-friendly acts and a carbon tax on consumer behaviour in online food retailing. Experimental research has recently observed that recalling past behaviour produces compensatory effects in line with moral licensing (Khan and Dhar 2006; Sachdeva et al. 2009), as well as moral cleansing/consistency effects (Nikolova, Lamberton, and Haws 2016), in line with self-perception or dissonance reduction approaches (Dickerson et al. 1992; Freedman and Fraser 1966). A key question addressed by this research is which of these effects appear in complex real life situations where consumers are subjected to a multiplicity of stimuli. In addition, current debates on environmental policy support the introduction of a carbon tax, but there remain questions on the effectiveness of this intervention due to limited empirical research on this topic. This section discusses the implications of our results in light of the existing literature on moral decision-making and carbon taxation.

5.1. The impact of environmental recall on the carbon footprint of a basket

The first element of this discussion is the relation between the recall of past environmentally-friendly behaviour and the current carbon footprint of the consumer. As discussed previously, the environmental recall treatment made the amount of the carbon saved in the previous week salient and exactly known (with the general uncertainties associated with the imprecision of carbon lifecycle measures). Given the link between present and past carbon footprint, the increase in moral self-worth θ could have been used immediately, causing moral licensing, or could have been stored to raise the stock of pro-environmental self-worth. Previous research already noted that moral self-worth shocks do not always lead to moral licensing (Blanken et al. 2015), but it is the individual interpretation of the behaviour as a self-signal of a virtuous self-concept that determines whether past virtuous behaviour leads to future virtuous behaviour (see Effron and Conway 2015; Mullen and Monin 2016 for comprehensive reviews of the literature). This article contributes to the ongoing debates on moral self-regulation by showing that the recollection of previous pro-environmental behaviour leads to consistency effects and promotes subsequent pro-environmental behaviour. Notably, while psychological studies that test for moral licensing tend to use hypothetical choice situations, this study observes multiple instances of behaviour using an incentive-compatible mechanism that makes choices real.

Methodologically, our recall questionnaire differs from those used in the literature, where consumers are asked to write about past pro-social or anti-social acts (Sachdeva et al. 2009), or instances of self-control success or failure (Mukhopadhyay et al. 2008; Nikolova et al. 2016) in a free recall task. Our questionnaire asked consumers to indicate the frequency of a set of pro-environmental behaviours that were presented to them in a list. Because no consumer engaged in all the measured environmental activities of Table 1, the task might have reminded consumers of how much they had *not* done in this area of behaviour, possibly causing feelings of cognitive dissonance (Dickerson et al. 1992). At the same time, because no participant reported zero carbon savings, some consumers may have felt that they had more carbon credits than they thought, receiving an unexpected "carbon allowance" that could be spent freely in the store (see e.g., Milkman and Beshears 2009). The results support the first of these two possibilities: the requirement to recall past behaviour, which provided an estimate of the amount of carbon saved in the past week, reduced the carbon footprint of baskets. However, the impact of the recall was the same irrespective of the actual amount of carbon consumers saved, which was not used to determine the carbon footprint of their basket. This result indicates that consumers did not view the carbon footprint saved as an allowance for their next consumption task. The lack of correlation between the carbon purchased in the store and the carbon reported as saved in the previous seven days could be explained by consumers considering these behaviours as belonging to different mental "carbon budgets" that are used independently on each other (see the literature discussed in Milkman and Beshears 2009); for instance, it may be that carbon saved from past recycling could be used to license current waste-related decisions, but not to purchase high-carbon food in a supermarket.

Previous research shows that when an initial act self-signals commitment to a goal, it motivates consistency over licensing in subsequent choices that pursue that same goal (Effron and Conway 2015; Fishbach and Dhar 2005, 2007). This association between consistency in the pursuit of a goal and perceived commitment to the goal is particularly important when feedback on successful actions is positive (Fishbach, Eyal, and Finkelstein 2010). As a result, consumers may have interpreted the presence of a positive value of carbon savings as a signal of their interest for environmental preservation, therefore motivating commitment to the environmental goal (see Baca-Motes et al. 2013); this perception may have then increased the importance given to the environmental quality of the basket. Indeed, participants received a reminder of the (presumably costly) effort they placed in activities that protect the environment

and prevent global warming, and the costliness of an act motivates consistency by functioning as a personal signal of commitment to the act itself (Gneezy et al. 2012).

The recall of past behaviour that specifically required individuals to exert restraint can also facilitate a consumer's ability to self-control. Specifically, the recall of past instances of self-control motivates the consistent pursuit of the self-control in non-impulsive individuals, particularly when the reason that led to the initial act is recalled as well (Mukhopadhyay et al. 2008): the conflict between restraint and desire is relatively smaller in non-impulsive individuals, and the evidence of goal progress directs the attention to the pursuit of the initial goal (restraint), rather than on the failure to progress in the alternative goal (desire). As a result, the results in this exercise might be caused by a sample of non-impulsive shoppers who recalled past instances of successful environmental preservation, leading to the construction of low-carbon baskets. At the same time, the recall of past successful instances of self-control has a positive effect on the mood of consumers, and increases their belief on their own ability to self-control, an effect that is particularly strong when past successes are easy to recall (Nikolova et al. 2016). Environmental priming may also have been at work, analogously to how this appears to work in other contexts in inducing pro-social behaviour (e.g. Cookson 2000; Elliott et al. 1998; Liberman et al. 2004).

The lack of a clear relationship between environmental self-image and environmental behaviour is somewhat surprising. Theories of moral self-regard view the distance to the ideal moral-self as a key factor in driving moral behaviour (Monin and Jordan 2009). This relation should exist in all treatments (including the two control groups), and should be stronger under psychological stimuli that increase salience of the distance between actual and ideal moral self (as in the environmental recall task). However, we fail to find a clear link between environmental self-image and carbon footprint: the rank correlation (Table 5) is only occasionally significant in week 2 only. Figure 7 also shows that overall the relationship between environmental self-image scale and the carbon footprint of a basket is characterised by a relatively flat line in both weeks, supporting the evidence of a limited link between the two. As the self-image question did not clearly probe recent behaviour[27], the failure to find a relation could be due to the general nature of the self-image scale and a mismatch with the specific domain of supermarket shopping (Panzone et al. 2016 discuss some issues associated to the classic problem of attitude-behaviour measurement specificity). However, given the

[27] A more precise question might have been along the lines of "With respect to the environmentally friendly person I want to be my recent behaviour has been not up to standard/has been up to standard".

limited statistical power due to a relatively small sample, we leave the task of verifying the robustness of this result to future research.

5.2. The impact of a carbon tax on the carbon footprint of a basket

A second experimental treatment tested the viability of an income-neutral carbon tax as a means to reduce the carbon footprint of food baskets. Results indicate that sufficiently high carbon taxes (£70/tonne CO_2e, in line with directives from DECC (2016), and equivalent to an average increase of 8.47% in market prices) are effective in reducing carbon footprints. The introduction of the carbon tax showed a significant potential for carbon reduction in a context where expenditures were real, with baskets containing 2.5-3.3 kg CO_2e less than the "Control" group (15-19% reductions). This sizeable effect is fairly stable across model specifications. Because the revenues from the tax were redistributed to participants in the tax treatment (who were clearly notified before they started shopping), these results indicate that consumers switched to now cheaper low-carbon options rather than consuming less (and, as discussed previously, income effects are unlikely to have affected our estimates). This reduction might have been facilitated by the easy access to close substitutes in the shop (e.g. smaller sizes of the same good, or low-carbon options), and might not be replicable in contexts or choice sets where substitution is more complex, either because a direct low-carbon substitute does not exist, or because consumers do not perceive an existing substitute as easy to use or consume (e.g. shifting from dairy yoghurt to a vegetarian soya dessert substitute). The effect of the carbon tax also adds to the effect of the environmental recall questionnaire, but results provide no evidence of a multiplicative effect: the two effects do jointly work in the marketplace, but there is no evidence of interaction between them.

In the experiment, the carbon tax was simplified to the extent that it imposed a full pass-through of the tax: the price of the good increased perfectly by the amount of the tax, with no adjustments of the supply side of the market (e.g. Kenkel 2005). If retailers can adjust by increasing prices beyond the value of tax, or can absorb part of the price increase (e.g., by switching to cheaper suppliers), then the effect of the tax would be higher or lower than we observe in this article. At the same time, the design of the experiment clearly informed consumers of the presence of a carbon tax, both explaining its presence before consumers entered the store, and announcing the amount next to the price of each product in store. Consumers may have used the tax as information on the environmental quality of each product,

as well as on the interest of the policymaker in discouraging the consumption of certain products (McAdams 1997; Sunstein and Reisch 2014). To this extent, research has shown that taxes advertised to consumers may have an additional behavioural effect beyond the pure price effect (see Chetty, Looney, and Kroft 2009; Zizzo et al. 2016). Nevertheless, given the absence of the carbon tax in the actual marketplace, the direct reference to a carbon tax was used to ensure participants could access information on the tax relatively easily during a time-consuming task like shopping in a new and unfamiliar supermarket.

The strong response observed in the results is an indication that consumers are sensitive to food price increases. In fact, results suggest that consumers found adjustments in this sector relatively simple to obtain, responding to the change in prices by substituting to foods with lower carbon footprint. However, consumers might be more price-sensitive in a laboratory experiment, particularly if they can substitute behaviour in a taxed environment with unobserved behaviour in a tax-free store outside of the laboratory. We show that this behaviour is unlikely to have had a significant impact in our data, but cannot be totally ruled out. Moreover, because of the design of the tax treatment, and the inability to track out-of-lab behaviour, the estimated effect of the carbon tax is an upper boundary of the effectiveness of the tax, and real life implementations might result is somewhat lower estimates. On the other hand, if the tax was applied universally in a jurisdiction (therefore effectively removing the outside good), the response might be somewhat stronger, because consumers would be unable to keep the money and spend it on the same untaxed product elsewhere. This difference in price sensitivity is an empirical research question that should be tested in future research to validate the results from experimental research. Finally, while this study did not formally assess the acceptance of the carbon tax in the marketplace, results clearly indicate that a carbon tax can be a viable and effective tool for or reducing food-related carbon emissions.

5.3. The quest for consistency in the construction of sustainable food baskets

As phenomena like moral licensing gained increasing attention in academic and policy arenas, a key policy question is how consumers can be motivated to engage in sustainable consumption consistently over time (Joosten et al. 2014; Mullen and Monin 2016). Results in this article indicate that policy can motivate consistency in sustainable online food shopping. In fact, conventional policy tools like carbon taxes may motivate consumers to reduce their carbon footprint, and it is possible that sizeable reductions will be obtained purely driven by the change

in relative prices, and without altering the psychological mind-set of consumers. Conceivably, other price-based interventions from marketing (discounts) or public policy (subsidies) could facilitate the transition to low-carbon food shopping. Apart from conventional policy instruments, behavioural interventions can also reduce the carbon footprint of the consumer (McAdams 1997; Sunstein and Reisch 2014): a simple nudge like encouraging the recall of recent environmental behaviour has a comparable effect (in terms of the magnitude of the final reduction) to a sizeable carbon tax in driving consistent behaviour. However, while a carbon tax can be implemented in a broader range of shopping environments, this nudge is specific: it would easily work in an online store, but not in a physical shopping environment – for instance, the consumer could provide information on environmental behaviours to retailer through mobile applications, or a short survey before shopping online. Online shopping would also allow consumers to monitor the carbon footprint of their shopping basket. These effects remain when the nudge is presented jointly with the carbon tax. The interaction between nudges and traditional policy instruments is currently understudied (Sunstein and Reisch 2014), and could be developed to design effective social marketing campaigns that selectively target consumers with different levels of environmental engagement.

As with most behavioural and experimental literature, it remains unclear whether the effect of these interventions wears out over time. In fact, depending on the intervention being considered, the policymaker might either maintain the policy mechanism (as commonly done for taxes) or remove it (as is the case of exogenous shocks or experimental research in a lab). The addition of a long-term perspective raises questions on the long term effectiveness of a policy instrument (see e.g. Dolan, Galizzi, and Navarro-Martinez 2015). A limitation of this study is that the two-week experiment only allows us to observe the short-run impact of nudges and carbon taxes, with no information of the long-term effects of the intervention. For instance, consumers might become used to the price increase caused by the carbon tax, adapting to the new set of prices over time. At the same time, a dynamic tax that is periodically updated to represent the price of carbon over time could prevent this behavioural adaptation. As an example, recent research shows that nudges based on social norms can have persistent long-term effects on energy consumption if periodically re-instated (Allcott and Rogers 2014); but the monetary incentives associated to a new tax appear more persistent than the motivational incentives of the same intervention (Larcom, Panzone, and Swanson 2017). A study of the long term impact of a policy on consumption would require the observation of a panel of consumers over a number of time periods in a controlled environment or in existing commercial panels,

with periodically changing regulatory set-up. Further research could explore these dynamics in more detail.

6. CONCLUSIONS

This article tested for the role of environmental recall and carbon taxation on the sustainability of food shopping using incentive-compatible experimental data. Using an online supermarket, the experiment showed that a carbon tax has a strong impact on the carbon footprint of the basket. When controlling for individual heterogeneity, we also find evidence that the act of recalling past behaviour also motivated the formation of low-carbon baskets. As a result, policy interventions can successfully reduce the carbon footprint of food baskets through either more classical (e.g. tax) and more innovative (e.g. nudges) policy instruments. The effectiveness of the different policy options over time is not studied in this exercise, and ways of promoting their sustainability over time constitute an important challenge for future research in this domain in order to ensure long-term benefits to society.

FIGURES

Figure 1: Screenshot of the online retailer

Figure 2: Diagrammatic representation of the experiment

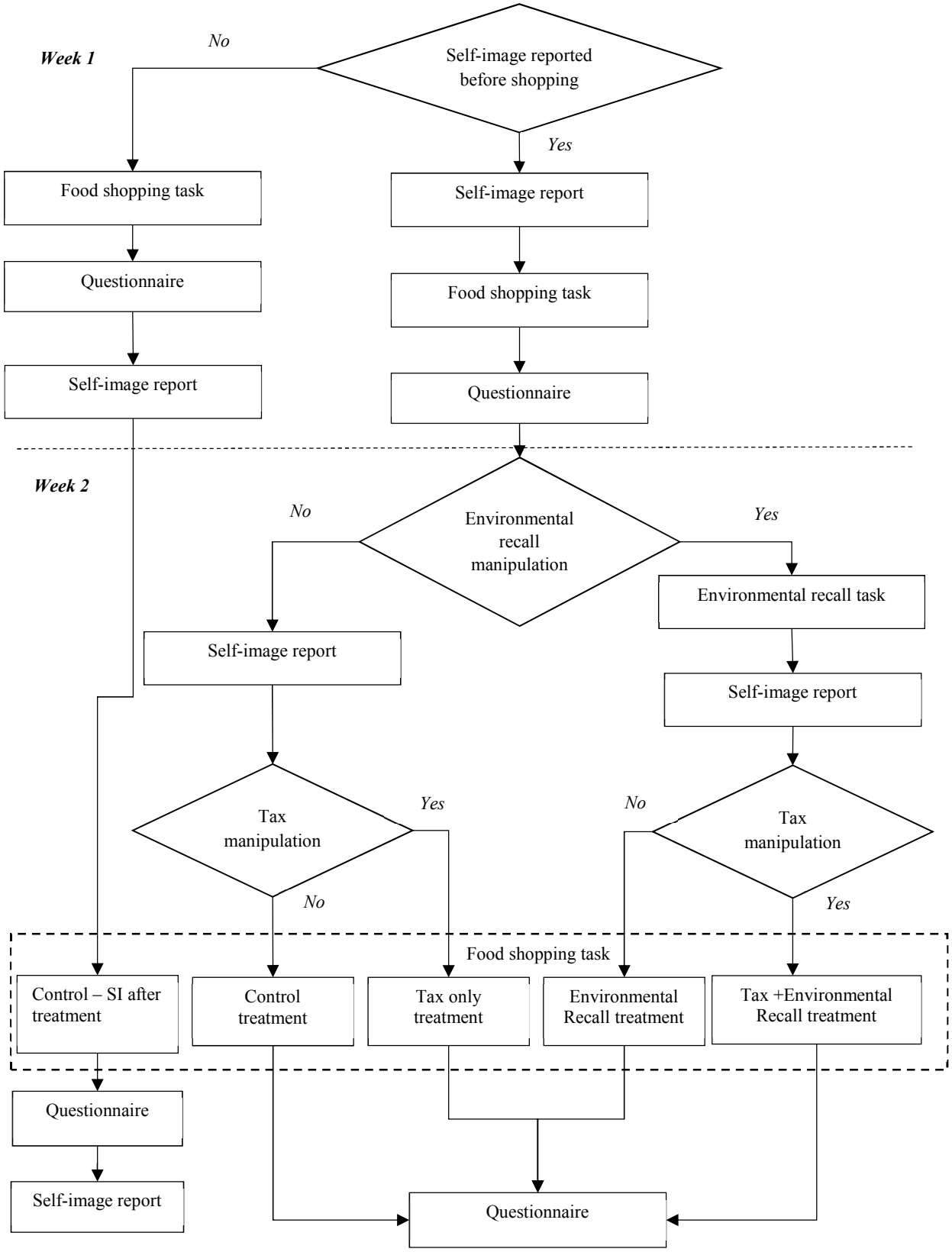
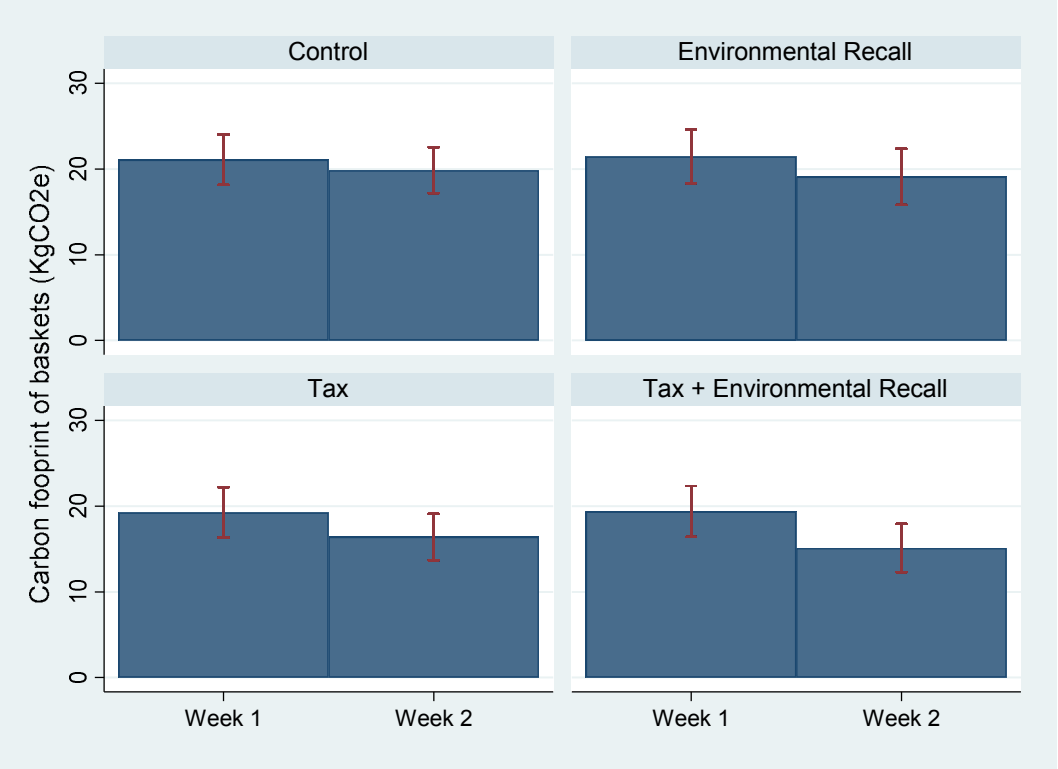
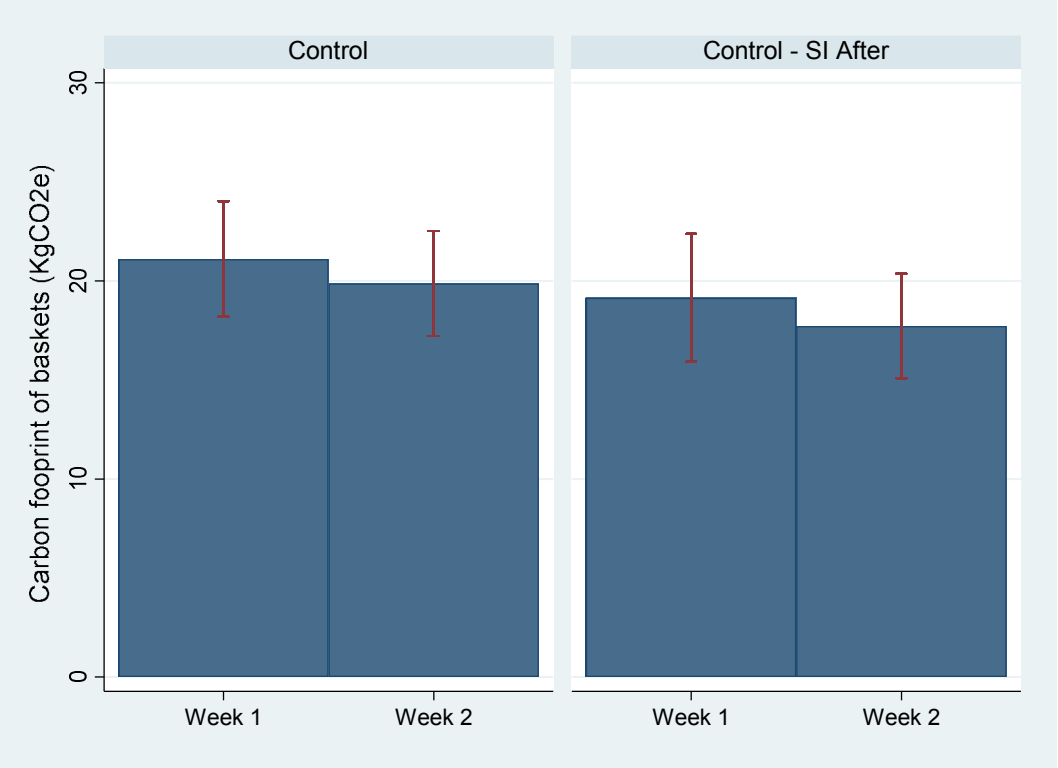


Figure 3: Changes in average basket carbon footprint across time period, by treatment



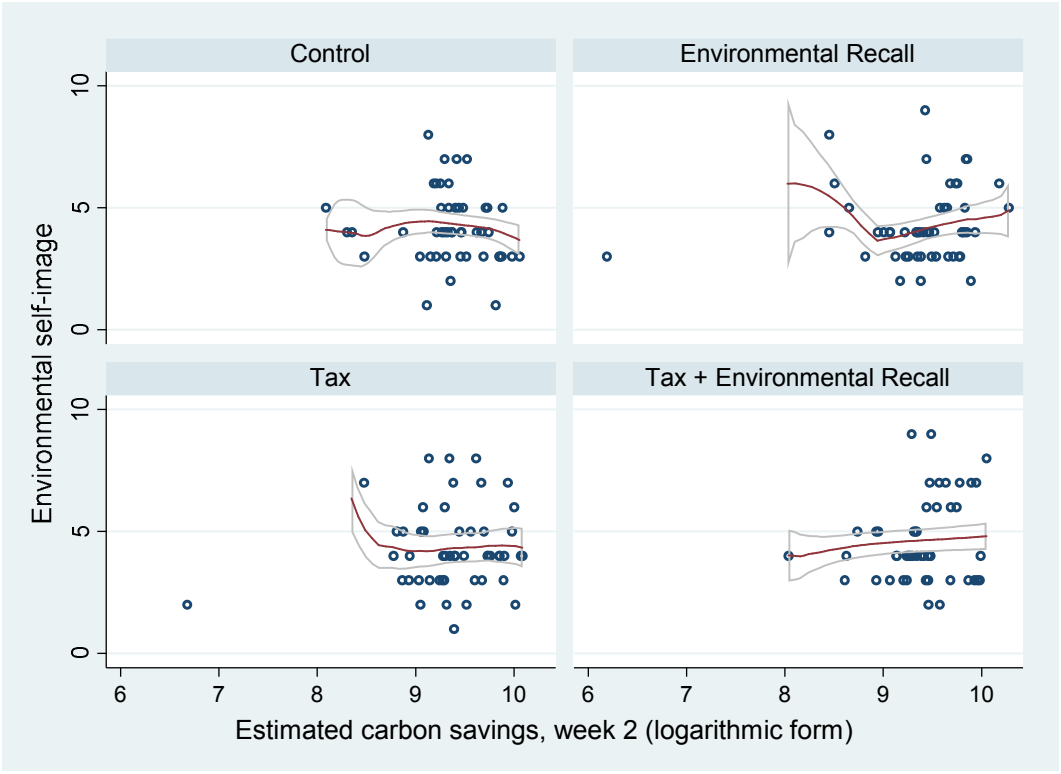
Note: Two-sample Kolmogorov-Smirnov test for equality of distribution functions – "Control" treatment: D = 0.1348 (corrected p = 0.803); "Environmental recall" treatment: D = 0.2157 (corrected p = 0.136); "Tax" treatment: D = 0.1800 (corrected p = 0.316); "Tax + Environmental recall" treatment: D = 0.2245 (corrected p = 0.122).

Figure 4: Changes in average basket carbon footprint across time period in control groups, by presence vs absence of a self-image question before the shopping task



Note: Two-sample Kolmogorov-Smirnov test for equality of distribution – "Control" treatment: D = 0.125 (corrected p = 0.803); "Control – SI after" treatment: D = 0.161 (corrected p = 0.815).

Figure 5: Relation between estimated carbon savings and environmental self-image in each experimental condition



Note: graphs refer to scatterplots with a local polynomial regression of degree 0 and 95% confidence intervals. The graphs only include observations where the self-image question was asked before shopping. The fitted line refers to a non-parametric local polynomial regression with local-mean smoothing.

TABLES

Table 1: List of environmental activities and their CO_2e impact in the environmental recall task

Act/Frequency	g CO_2e	Units
Eaten a standard 10g portion of margarine rather than the same amount of butter	81	10 g
Used my own bag for shopping instead of using a plastic bag supplied by the retailer	10	Bag
Eaten 100g of meat substitutes rather than 100g of beef ***100g of meat equals to: a 5oz rump steak; just over a portion of Sunday roast (three thin-cut slices of roast = 90g); or a bit more than one quarter-pounder beef burger (= 78g).***	215.7	100 g
Took a shorter (2-minute) shower than the UK average (8-minute)	540	Shower
Walked rather than driven to go to University	106	Km
Cycled rather than driven to go to University	106	Km
Walked rather than took public transport to go to University	93.3	Km
Cycled rather than took public transport to go to University	-86.7[28]	Km
Washed clothing at 30 degrees rather than 60 degrees	360	Wash
Turned off your laptop completely rather than leaving it on standby	4.4	Day
Turned off your TV completely rather than leaving it on standby	4.4	Day
Turned off the tap when brushing teeth	13.5	Times
Did not waste any of the food on my plate when eating in a meal.	480	Plate
Recycled one plastic bottles	44.5	Bottle
Recycled one aluminium can	70	Can
Put an old newspaper in the recycling bin instead of the garbage bin	225	Newspaper
Put an old magazine in the recycling bin instead of the garbage bin	600	Magazine
Recycled the equivalent of one 750-ml glass bottle (typical size of a wine bottle)	73.9	750 ml bottle
Recycled the equivalent of one 500-ml glass bottle (typical size of a one-pint beer or milk bottle)	112	500 ml bottle
Recycled the equivalent of one 330-ml glass bottle (typical size of a small beer bottle)	168	330 ml bottle
I turned off unnecessary lights in my home (enter number of days)	665.7	Day

Table 2: Summary demographics of the sample by treatment

	Control – SI After	**Control**	**Moral Recall**	**Tax**	**Moral Recall x Tax**	χ^2
Male	0.23	0.31	0.37	0.34	0.41	3.296

[28] This value adds the carbon emissions associated to a shower straight after cycling.

S. D.	0.43	0.47	0.49	0.48	0.50	
Age	24.89	23.38	24.40	24.80	23.36	1.777
S. D.	9.88	4.64	6.73	5.91	4.18	
British	0.55	0.49	0.67	0.46	0.33	9.094*
S. D.	0.51	0.51	0.48	0.50	0.47	
Member of Environmental Association	0.06	0.08	0.10	0.10	0.06	0.179
S. D.	0.25	0.28	0.30	0.30	0.24	
CO_2e Savings (g) – week 2	13,133	12,774	13,386	13,004	12,898	0.776
S. D.	4,844	4,992	5,430	5,310	4,663	
Env. Self-Image – week 1	3.68	4.18	4.33	4.18	4.29	4.58
	1.51	1.69	1.51	1.59	1.57	
Env. Self-Image – week 2	3.87	4.18	4.29	4.30	4.61	2.99
	1.02	1.45	1.51	1.68	1.73	
Observations	31	49	51	50	49	

Significance is as follows: * = 10%; ** = 5%; *** = 1%. Note: χ^2 refers to the critical value of a Kruskal-Wallis Test comparing demographics across group.

Table 3: Summary expenditures and saving statistics by treatment group and week.

		Expenditures		**Tax paid**	**Savings**		**N**
	Week	**1**	**2**	**2**	**1**	**2**	
Control – SI After	Mean	£19.18	£18.25	0	£5.82	£6.75	31
	S. D.	5.90	6.31	0	5. 90	6.31	
	Change		-£0.94			£0.94	
Control	Mean	£17.73	£16.58	0	£7.27	£8.42	49
	S. D.	7.29	7.45	0	7.29	7.46	
	Change		-£1.16*			£1.16*	
Env. Recall	Mean	£17.63	£16.48	0	£7.37	£8.52	51
	S. D.	6.81	7.47	0	6.81	7.47	
	Change		-£1.16*			£1.16*	
Tax	Mean	£17.47	£16.59	£1.14	£7.53	£8.41	50
	S. D.	7.12	8.06	0.67	7.12	8.06	
	Change		-£0.88*	-		£0.88*	
Tax + Env. Recall	Mean	£17.02	£15.33*	£1.03	£7.98	£9.67	49
	S. D.	7.33	8.31	0.69	7.33	8.31	
	Change		-£1.69*	-		£1.69*	
Kruskal-Wallis χ^2		1.422	2.262	203.771***	1.422	2.263	

Note: Expenditures in the tax treatment refer to gross expenditures (i.e. with tax); savings refer to the unspent balance before the redistribution of tax revenues. A significant change refers to a Wilcoxon matched-pairs signed-ranks test between the variable in Week 2 and Week 1. χ^2 refers to the critical value of a Kruskal-Wallis Test comparing expenditures, tax paid, and savings across the five groups. Significance is as follows: * = 10%; ** = 5%; *** = 1%.

Table 4: Summary basket statistics by treatment group and week.

		CO_2 footprint (gCO_2e)		CO_2 footprint/£		Kilocalories		Fats (g)		Salt (g)		Proteins (g)		Sugars (g)		N
	Week	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	
Control - After SI	Mean	19,142	17,722	1,003	1,000	13,165	11,912	480	446	21	20	520	449	427	443	31
	S. D.	8,808	7,208	387	313	7,097	6,431	367	393	15	14	241	212	295	355	
	Change		-1,404		-3		-1,253		-34		-1		-71***		+16	
Control	Mean	21,381	19,878	1,216	1,226	12,984	11,583	467	398	72	114	535	482	406	426	49
	S. D.	1,491	1,319	361	494	7,303	7,163	393	348	237	330	249	242	257	288	
	Change		-1,503		-10		-1,401**		-69		+42		-53***		+20	
Env. Recall	Mean	21,494	19,118	1,200	1,141	13,316	10,661	466	359	58	40	552	476	450	386	51
	S. D.	1,548	1,634	364	408	8,142	7,455	394	364	209	108	306	279	403	298	
	Change		-2,376**		-59		-2,655***		-107**		-18		-76**		-64	
Tax	Mean	19,258	16,404	1,113	1,018	11,794	9,933	373	297	55	35	474	414	482	439	50
	S. D.	1,461	1,346	457	329	7,602	6,798	307	333	149	107	264	241	324	326	
	Change		-2,854***		-95***		-1,861**		-76***		-20***		-60***		-43*	
Tax + Env. Recall	Mean	19,347	15,120	1,187	965	11,811	11,116	463	440	82	33	443	385	429	419	49
	S. D.	1,471	1,406	518	427	6,937	8,010	436	465	206	108	261	265	316	347	
	Change		-4,227***		-222***		-696		-23		-49***		-58*		-10	
Kruskal-Wallis χ^2		2.49	7.14	8.43*	15.25***	2.29	2.71	2.12	5.04	4.95	8.33*	5.56	5.97	1.65	1.03	

Note: A significant change refers to a Wilcoxon matched-pairs signed-ranks test between the variable in Week 2 and Week 1. χ^2 refers to the critical value of a Kruskal-Wallis Test comparing behaviour and self-image across the five groups. Significance is as follows: * = 10%; ** = 5%; *** = 1%.

Table 5: Spearman correlations between environmental self-image and related variables.

Week	Variable	Control – After SI	Control	Recall	Tax	Tax + Recall	All Sample
1	**Identity – Symbolisation**	0.239	0.633***	0.276	0.318	0.374	0.367***

	Identity – Internalisation	-0.096	0.060	0.050	0.201	0.158	0.078
	CO_2e consumed	-0.110	-0.106	-0.283	-0.182	0.010	-0.131
	Recalled CO_2e Savings	0.160	-0.008	0.048	0.029	0.015	0.032
2	**Identity – Symbolisation**	0.563**	0.498***	0.421**	0.245	0.424**	0.412***
	Identity – Internalisation	0.251	0.006	0.068	0.169	0.000	0.055
	CO_2e consumed	-0.098	-0.385**	-0.305*	-0.115	-0.204	-0.221***
	CO_2e Savings	0.327	-0.162	0.187	0.071	0.174	0.087

Note: significance is based on p-values after a Bonferroni adjustment, regressing multiple correlations of carbon variables and psychometric variables separately for consistency in the adjustment.

Table 6: Regression estimates of the impact of experimental treatments on the CO_2e of the basket (week 2)

Model	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**
Dependent variable	**ln(CO2e)**					**ln(CO2e/£)**				
Intercept	9.7953***	0.0183	-0.0066	0.2931	4.9396***	7.0828***	2.7936**	2.5712**	2.4510**	2.4585**
S.E.	0.0943	1.5438	1.5496	1.5458	1.1026	0.0441	1.1674	1.1301	1.1274	1.1503
Carbon tax	-0.3646***	-0.1855**	-0.1515**	-0.1419**	-0.1590***	-0.2111***	-0.1656***	-0.1472***	-0.1512***	-0.1519***
S.E.	0.1289	0.0750	0.0741	0.071	0.0522	0.0608	0.0493	0.0503	0.0495	0.0496
Environmental Recall	-0.2145*	-0.1725**	-0.1664**	-0.1746**	-0.1444**	-0.1247**	-0.1461***	-0.1375***	-0.1570***	-0.1602***
S.E.	0.1286	0.0831	0.0820	0.0868	0.0594	0.0605	0.0523	0.051	0.0555	0.0598
$Ln(CO2e)_{t-1}$	-	0.8228***	0.8084***	0.8008***	0.1628*	-	-	-	-	-
S.E.		0.0604	0.0608	0.0647	0.0967					
$Ln(CO2e/£)_{t-1}$	-	-	-	-	-	-	0.4997***	0.5271***	0.5270***	0.5329***
S.E.							0.1475	0.146	0.1453	0.1369
Ln(CO_2e savings)	-	0.1788	0.1727	0.1540	0.0932	-	0.0831	0.0843	0.0703	0.0710
S.E.		0.1616	0.164	0.1705	0.0978		0.0838	0.0807	0.0855	0.0871

Male	-	-	-0.1262	-0.1323	-0.1244*	-	-	-0.1596***	-0.1717***	-0.1726***
S.E.			0.0926	0.0920	0.0677			0.0615	0.0615	0.0625
Age	-	-	0.0067	0.0069	-0.0004	-	-	0.0015	0.0040	0.0044
S.E.			0.0064	0.0069	0.0057			0.0047	0.0052	0.0055
British	-	-	0.1783**	0.1438	0.0457	-	-	0.0578	0.0359	0.0445
S.E.			0.0732	0.0894	0.0738			0.0582	0.0664	0.0789
Identity – Internalization	-	-	-	-0.0609	-0.0328	-	-	-	-0.0339	-0.038
S.E.				0.0522	0.0364				0.0324	0.0338
Identity – Symbolization	-	-	-	0.0294	-0.0406	-	-	-	-0.0487	-0.0463
S.E.				0.0519	0.0316				0.0346	0.0333
Knowledge	-	-	-	0.0668**	0.0324	-	-	-	0.0268	0.0285
S.E.				0.0325	0.0260				0.0262	0.0281
Attitudes	-	-	-	-0.0044	0.0032	-	-	-	0.0115	0.0121
S.E.				0.0186	0.0114				0.0116	0.0121
Ln(Expenditures)	-	-	-	-	0.8659***	-	-	-	-	-0.0266
S.E.					0.1079					0.0715
Day of the week	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimation	OLS	SUR	SUR	SUR	SUR	OLS	SUR	SUR	SUR	SUR
Marginal – Env. Recall	-3,802.86	-3,056.83	-2,950.24	-3,094.35	-2,558.74	-2,210.92	-2,589.19	-2,437.91	-2,783.47	-2,840.21
Marginal – Tax	-6,463.71	-3,288.89	-2,686.10	-2,515.97	-2,818.52	-3,742.52	-2,936.03	-2,609.52	-2,679.53	-2,691.93
Observations	198	198	198	198	198	198	198	198	198	198
R^2	0.052	0.6345	0.6481	0.6596	0.8233	0.076	0.2837	0.3173	0.3299	0.3324
Adjusted R^2	0.042	-	-	-	-	0.067	-	-	-	-
Log-likelihood	-259.41	-308.18	-547.79	-531.57	-306.42	-110.5	-228.48	-316.03	-309.59	-305.76

Significance is as follows: * = 10%; ** = 5%; *** = 1%. S.E. refers to robust standard for OLS, and bootstrapped standard errors (400 replications) for SUR estimates.

Table 7: Regression estimates of the determinants of the amount of carbon savings in the seven days before Week 2 shopping

Model	**B**	**C**	**D**	**E**	**B**	**C**	**D**	**E**
Intercept	9.3359***	9.0302***	8.8417***	8.8661***	9.4093***	8.9723***	8.9516***	8.7869***
S.E.	0.4759	0.4943	0.5822	0.5558	0.8191	0.8663	0.9251	0.9015
Ln(CO_2e)$_{t=1}$	0.0039	0.0027	0.0254	0.0225	-0.0051	0.0116	0.0204	0.0376
S.E.	0.0486	0.0482	0.0593	0.0555	0.1163	0.1157	0.1207	0.1173
Male	-	-0.0019	0.0286	0.0287	-	-0.0031	0.0301	0.0259
S.E.		0.0832	0.0815	0.0813		0.082	0.0821	0.0817
Age	-	0.0132*	0.0103	0.0103	-	0.0133*	0.0096	0.0108
S.E.		0.0071	0.007	0.007		0.0073	0.0071	0.0071
British	-	0.0008	0.0645	0.065	-	0.0014	0.0814	0.0687
S.E.		0.0687	0.0687	0.0682		0.0695	0.0658	0.0686
Identity – Internalization$_{t=1}$	-	-	0.1121***	0.1114***	-	-	0.1044***	0.1070***
S.E.			0.0422	0.0405			0.0403	0.0403
Identity – Symbolization$_{t=1}$	-	-	0.0309	0.0311	-	-	0.028	0.0324
S.E.			0.0433	0.0432			0.041	0.0416
Attitudes$_{t=1}$	-	-	-0.0016	-0.0015	-	-	0.0001	-0.0004
S.E.			0.0142	0.0141			0.0138	0.0139
Day of the week	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimation	SUR	SUR	SUR	SUR	SUR	SUR	SUR	SUR
Observations	198	198	198	198	198	198	198	198
R^2	0.0000	0.0427	0.1168	0.7957	0.0000	0.0305	0.0373	0.0625

Significance is as follows: * = 10%; ** = 5%; *** = 1%. S.E. refers to bootstrapped standard errors (400 replications). Note: Identity (Internalization and Symbolization) and attitudes refer to the answer consumers gave in the first week.

Table 8: Regression estimates of the determinants of the CO_2e and of CO_2e/£ of the basket (week 1)

Model	C	D	E	C	D	E
Dependent	**ln(CO2)**			**ln(CO2/£)**		
Intercept	9.4067***	8.4910***	7.1024***	7.1335***	7.0748***	7.1310***
S.E.	0.3084	0.6224	0.2614	0.1591	0.2860	0.2645
Male	0.104	0.0562	0.1190**	0.1241**	0.1171*	0.1154*
S.E.	0.1395	0.1399	0.0603	0.057	0.0619	0.0608
Age	0.0041	0.0105	-0.0100	-0.0078	-0.0067	-0.0090
S.E.	0.0116	0.0135	0.0078	0.0065	0.0072	0.0080
British	0.3421***	0.2028*	0.0471	0.0213	0.0200	0.0333
S.E.	0.126	0.1107	0.0631	0.0565	0.0590	0.0629
Identity – Internalization	-	-0.2398***	0.0157	-	-0.0055	0.0001
S.E.		0.0709	0.0386		0.0364	0.0404
Identity – Symbolization	-	0.0119	-0.0374	-	-0.0352	-0.0373
S.E.		0.0581	0.0313		0.0325	0.0322
Knowledge	-	-0.0015	-0.0024	-	0.0057	0.0068
S.E.		0.0677	0.0282		0.0320	0.0304
Attitudes	-	0.0519**	-0.0003	-	0.0017	0.0000
S.E.		0.0224	0.0119		0.0109	0.0127
Ln(Expenditures)	-	-	1.0555***	-	-	0.0321
S.E.			0.0823			0.0877
Day of the week	Yes	Yes	Yes	Yes	Yes	Yes
Estimation	SUR	SUR	SUR	SUR	SUR	SUR
Observations	198	198	198	198	198	198
R^2	0.0210	0.0659	0.0659	0.0211	0.0572	0.0649

Significance is as follows: * = 10%; ** = 5%; *** = 1%. S.E. refers to bootstrapped standard errors (400 replications). Note: Identity (Internalization and Symbolization) and attitudes refer to the answer consumers gave in the first week.

Table 9: Estimated elasticities from the Almost Ideal Demand System (week 2)

Elasticity			Control	Env. Recall	Tax	Tax + Env. Recall	χ^2
Own-price	Drinks		-12.97	-15.05	-14.10	-14.01	1.32
	Meat		-1.24	-1.31	-0.80	-0.32	12.81***
	Fruit & vegetables (F&V)		-5.78	-3.34	-4.65	-3.62	4.03
	Cereals		0.02	-0.19	-1.26	-0.06	0.53
	Other animal origin		-2.10	-1.66	-1.94	-1.83	2.45
	Other F&V origin		-30.10	-31.27	-50.07	-17.96	3.53
	Ready meals		-7.72	-11.48	-11.37	-7.05	0.71
	Savings		-19.91	-36.49	-36.01	-17.66	0.71
Cross-price	Savings	Drinks	2.11	3.46	3.17	2.29	3.51
		Meat	2.33	2.31	2.33	3.56	1.31
		F&V	2.44	1.95	1.99	1.94	2.46
		Cereals	1.65	1.88	1.81	1.67	0.69
		Other animal origin	2.58	2.88	2.02	1.94	3.06
		Other F&V origin	3.23	4.83	2.32	1.67	2.05
		Ready meals	1.21	1.19	1.28	1.37	0.73
	Drinks	Meat	-1.53	-1.87	-1.41	-3.01	0.54
		F&V	2.08	1.86	2.11	1.97	0.96
		Cereals	-5.30	-4.71	-3.90	-7.47	0.93
		Other animal origin	2.46	2.72	2.53	2.06	1.12
		Other F&V origin	1.65	2.22	2.05	1.47	4.36
		Ready meals	3.23	3.81	4.09	3.20	1.14
	Meat	F&V	0.70	0.77	0.76	0.64	6.92
		Cereals	1.46	1.51	1.44	1.45	0.57
		Other animal origin	-0.27	-0.41	0.14	-1.32	9.48
		Other F&V origin	-3.91	-5.41	-6.53	-5.35	1.57
		Ready meals	2.03	1.92	1.60	3.32	2.53
	F&V	Cereals	1.08	1.05	1.08	1.07	1.25

	Other animal origin	-0.45	-0.03	-0.14	-0.06	1.77*
	Other F&V origin	4.14	3.01	3.44	4.82	1.36
	Ready meals	-4.72	-2.63	-4.85	-4.07	3.59**
Cereals	Other animal origin	-2.64	-3.57	-1.85	-1.50	2.57
	Other F&V origin	6.31	5.68	5.35	5.72	0.32
	Ready meals	-7.27	-5.97	-6.46	-4.62	0.62
Other anim. Origin	Other F&V origin	2.59	2.24	2.62	2.42	0.80
	Ready meals	-2.09	-0.46	-0.62	-0.27	4.97
Other F&V origin	Ready meals	8.49	17.26	56.93	10.48	5.24

Significance is as follows: * = 10%; ** = 5%; *** = 1%. Note: χ^2 refers to the critical value of a Kruskal-Wallis Test comparing elasticities across group.

APPENDIX 1. ADDITIONAL INFORMATION ON PSYCHOLOGICAL SCALES

1) ENVIRONMENTAL IDENTITY SCALE

To estimate the moral identity scale, the approach follows (Aquino and Reed 2002). Specifically, participants had to identify their agreement with a list of statements associated with being "environmentally-friendly" as the only personal characteristic. Answers were then analysed using a principal component analysis (PCA) with Varimax rotation after reverse scoringing the two negative statements ("I would be ashamed to be a person who has these characteristics" and "Having these characteristics is not really important to me"). Results are reported in table A1 below, and mirror the results presented in Aquino and Reed (2002). In particular, the PCA obtains 2 factors: a first factor consists of six items that measure the **internalisation** of pro-environmental identity, the extent by which this identity is central to the self-concept of the respondent; while a second factor of seven items measures the **symbolisation** of pro-environmental identity, which measures the degree to which the respondent feels this identity is reflected in his actions and behaviours. The variables used in the final regression refer to the estimated Bartlett score from the PCA.

Table A1: Rotated factor loadings from the PCA

		Week 2		**Week 1**	
		Symbolisation	**Internalisation**	**Symbolisation**	**Internalisation**
1	Caring for the environment is an important part of who I am.	0.4858	**0.7078**	0.5525	**0.6126**
2	I often buy products that communicate the fact that I care for the environment	**0.6320**	0.4718	**0.5535**	0.4099
3	The types of things I do in my spare time (e.g., hobbies) clearly identify me as caring for the environment.	**0.8161**	0.3108	**0.7816**	0.2082
4	The kinds of books and magazines that I read identify me as caring for the environment.	**0.8255**	0.2468	**0.7133**	0.2964
5	I am actively involved in activities that communicate to others that I care for the environment.	**0.8615**	0.1869	**0.8333**	0.2157

6	It would make me feel good to be a person who cares for the environment.	0.1062	**0.7824**	0.2471	**0.6778**
7	A big part of my emotional well-being is tied up in caring for the environment.	**0.6573**	0.5562	**0.7398**	0.4541
8	I would be ashamed to be a person who cares for the environment. (Reverse-coded)	-0.4474	0.4027	-0.4545	**0.5631**
9	Caring for the environment is not really important to me. (Reverse-coded)	0.0394	**0.7226**	0.1487	**0.7427**
10	Caring for the environment is an important part of my sense of self.	**0.6050**	0.5700	**0.6785**	0.5021
11	I strongly desire to care for the environment.	0.2971	**0.8226**	0.4774	**0.6073**
12	I often wear clothes that identify me as caring for the environment.	**0.8159**	0.0679	**0.7696**	0.0113
13	The fact that I care for the environment is communicated to others by my membership in certain organizations.	**0.8006**	0.1060	**0.7536**	0.0182

APPENDIX 2: ESTIMATED MAIN REGRESSION WITH INTERACTION TERM

Table A2: Regression estimates of the impact of treatments on the CO_2e of the basket (week 2)

Model	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**
Dependent	**ln(CO_2e)**					**ln(CO_2e /£)**				
Intercept	9.7649***	0.0014	-0.0077	0.2927	4.9380***	7.0802***	2.7638**	2.5572**	2.4576**	2.4456**
S.E.	0.0965	1.5537	1.5539	1.5566	1.109	0.045	1.1594	1.1288	1.1351	1.1482
Carbon tax	-0.3051**	-0.1473**	-0.1486*	-0.1396*	-0.1547**	-0.2060***	-0.1369**	-0.1284**	-0.1368**	-0.1371**
S.E.	0.1537	0.0734	0.0759	0.0842	0.0614	0.0647	0.0549	0.0566	0.0592	0.0592
Env. Recall	-0.1556	-0.1346	-0.1634*	-0.1722*	-0.1398*	-0.1196	-0.1179*	-0.1185*	-0.1424*	-0.1451*
S.E.	0.1487	0.0921	0.0912	0.1037	0.0763	0.0763	0.0641	0.0656	0.0742	0.0771
Carbon tax*Env.Recall	-0.1179	-0.0758	-0.006	-0.0047	-0.0088	-0.0102	-0.0564	-0.0382	-0.029	-0.0296
S.E.	0.2576	0.1527	0.1517	0.162	0.1017	0.1213	0.0988	0.0938	0.0986	0.098
Ln(CO_2e)$_{t-1}$	-	0.8225***	0.8084***	0.8008***	0.1630*	-	-	-	-	-
S.E.		0.0607	0.061	0.0647	0.0969					
Ln(CO_2e/£)$_{t-1}$	-	-	-	-	-	-	0.5018***	0.5283***	0.5275***	0.5342***
S.E.							0.1467	0.1457	0.1442	0.1368
Ln (Carbon saved)	-	0.1789	0.1728	0.1541	0.0932	-	0.0831	0.0846	0.07	0.0713
S.E.		0.1636	0.1647	0.1715	0.0984		0.0851	0.0815	0.0864	0.0878
Male	-	-	-0.1261	-0.1322	-0.1243*	-	-	-0.1594***	-0.1735***	-0.1723***
S.E.			0.0927	0.0923	0.0676			0.0615	0.0616	0.0624
Age	-	-	0.0066	0.0069	-0.0004	-	-	0.0012	0.0038	0.0042
S.E.			0.0063	0.0071	0.0056			0.0046	0.0051	0.0054
British	-	-	0.1778**	0.1433	0.0448	-	-	0.0546	0.034	0.0416
S.E.			0.0736	0.0901	0.0747			0.0577	0.0712	0.0797
Identity – Internalization	-	-	-	-0.061	-0.0329	-	-	-	-0.0344	-0.0384
S.E.				0.0526	0.0369				0.0333	0.0342
Identity – Symbolization	-	-	-	0.0295	-0.0403	-	-	-	-0.0475	-0.0456
S.E.				0.0544	0.0325				0.0352	0.0341
Knowledge	-	-	-	0.06672**	0.0322	-	-	-	0.026	0.028

S.E.				0.0325	0.0257				0.0257	0.0277
Attitudes	-	-	-	-0.0044	0.0032	-	-	-	0.0116	0.012
S.E.				0.0189	0.0114				0.0117	0.0121
Ln(Expenditures)	-	-	-	-	0.8658***	-	-	-	-	-0.0267
S.E.					0.1084					0.0714
Day of the week	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimation	OLS	SUR	SUR	SUR	SUR	OLS	SUR	SUR	SUR	SUR
Marginal – Env. Recall	-3687.07	-2982.78	-2944.41	-3088.64	-2547.86	-2200.92	-2535.21	-2401.58	-2752.34	-2805.51
Marginal – Tax	-6429.94	-3268.54	-2685.97	-2515.59	-2818.10	-3739.60	-2916.43	-2607.24	-2674.94	-2687.60
Observations	198	198	198	198	198	198	198	198	198	198
R^2	0.053	0.635	0.6481	0.6596	0.8233	0.076	0.2848	0.3177	0.3308	0.3327
Adjusted R^2	0.038					0.062				
Log-likelihood	-259.31	-308.07	-547.79	-531.57	-306.41	-110.49	-228.33	-315.96	-306.32	-305.72

Significance is as follows: * = 10%; ** = 5%; *** = 1%. S.E. refers to robust standard for OLS, and bootstrapped standard errors (400 replications) for SUR estimates.

APPENDIX 3: ESTIMATED DEMAND PARAMETERS – ALMOST IDEAL DEMAND SYSTEM

Table A3: Regression estimates of the Almost Ideal Demand System (week 2)

	Drinks	**Meat**	**F&V**	**Cereals**	**Other anim. origin**	**Other F&V origin**	**Ready meals**	**Savings**
Intercept	-0.0359	0.1403	-0.0301	-0.0157	0.4533**	-0.1684	-0.1779	0.8343
S.E.	0.1875	0.3706	0.2150	0.1343	0.1852	0.2808	0.3604	0.5234
ln(p Drinks)	0.0057	-0.0276	0.0106	-0.0384*	0.0128	0.0049	0.0136	0.0184***
S.E.	0.0289	0.0377	0.0202	0.0211	0.0278	0.0312	0.0388	0.0062
ln(p Meat)	-0.0276	0.0933	-0.0091	0.0072	-0.0390	-0.0909*	0.0168	0.0494***
S.E.	0.0377	0.0995	0.0382	0.0346	0.0493	0.0552	0.0776	0.0134
ln(p F&V)	0.0106	-0.0091	0.0063	0.0013	-0.0291	0.0480	-0.0607	0.0327***
S.E.	0.0202	0.0382	0.0287	0.0175	0.0237	0.0296	0.0380	0.0082

ln(p Cereals)	-0.0384*	0.0072	0.0013	0.0816**	-0.0430	0.0468	-0.0677*	0.0123**
S.E.	0.0211	0.0346	0.0175	0.0337	0.0276	0.0285	0.0360	0.0050
ln(p Other anim. origin)	0.0128	-0.0390	-0.0291	-0.0430	0.0697	0.0213	-0.0225	0.0298***
S.E.	0.0278	0.0493	0.0237	0.0276	0.0647	0.0386	0.0504	0.0068
ln(p Other F&V origin)	0.0049	-0.0909*	0.0480	0.0468	0.0213	-0.1619**	0.1173*	0.0145
S.E.	0.0312	0.0552	0.0296	0.0285	0.0386	0.0703	0.0634	0.0095
ln(p Ready meals)	0.0136	0.0168	-0.0607	-0.0677*	-0.0225	0.1173*	0.0002	0.0029
S.E.	0.0388	0.0776	0.0380	0.0360	0.0504	0.0634	0.1064	0.0126
ln(p Savings)	0.0184***	0.0494***	0.0327***	0.0123**	0.0298***	0.0145	0.0029	-0.1599***
S.E.	0.0062	0.0134	0.0082	0.0050	0.0068	0.0095	0.0126	0.0180
Environmental Recall	-0.0151	-0.0215	0.0200	-0.0143	0.0220	0.0293	-0.0399	0.0196
S.E.	0.0162	0.0357	0.0214	0.0124	0.0183	0.0257	0.0325	0.0492
Carbon tax	-0.0181	-0.0476	0.0277	0.0031	0.0268	0.0333	-0.0313	0.0061
S.E.	0.0161	0.0353	0.0207	0.0125	0.0176	0.0251	0.0321	0.0486
Knowledge	0.0028	-0.0010	0.0072	0.0142**	-0.0029	0.0066	-0.0077	-0.0193
S.E.	0.0079	0.0179	0.0106	0.0063	0.0094	0.0127	0.0163	0.0246
Identity – Internalization	-0.0053	-0.0133	-0.0093	-0.0030	-0.0097	-0.0065	-0.0065	0.0535**
S.E.	0.0087	0.0203	0.0113	0.0068	0.0099	0.0140	0.0183	0.0270
Identity – Symbolization	-0.0120	0.0189	0.0306**	0.0069	0.0193	0.0247	-0.0309	-0.0574*
S.E.	0.0104	0.0229	0.0134	0.0082	0.0117	0.0163	0.0221	0.0310
Attitudes	0.0003	-0.0089	0.0014	0.0026	0.0010	0.0014	-0.0005	0.0026
S.E.	0.0034	0.0075	0.0044	0.0027	0.0037	0.0055	0.0070	0.0102
Male	-0.0131	0.0126	-0.0361*	-0.0085	-0.0386**	0.0206	0.0418	0.0213
S.E.	0.0170	0.0369	0.0217	0.0131	0.0194	0.0258	0.0340	0.0500
British	-0.0198	-0.0237	0.0407*	0.0208	-0.0128	-0.0614**	0.0625*	-0.0064
S.E.	0.0178	0.0402	0.0231	0.0142	0.0201	0.0291	0.0358	0.0552
Age	-0.0017	-0.0055	0.0028	0.0010	0.0045**	0.0037*	-0.0033	-0.0015
S.E.	0.0016	0.0035	0.0020	0.0012	0.0018	0.0022	0.0034	0.0048
Ln(CO2e saved)	0.0090	0.0218	0.0106	-0.0023	-0.0545***	0.0186	0.0102	-0.0135
S.E.	0.0184	0.0350	0.0208	0.0131	0.0181	0.0269	0.0347	0.0526
Inventory: Drinks	0.0848***	-	-	-	-	-	-	-

S.E.	0.0161							
Inventory: Meat	-	0.1286***	-	-	-	-	-	-
S.E.		0.0352						
Inventory: Vegs	-	-	0.0121	-	-	-	-	-
S.E.			0.0213					
Inventory: Fruit	-	-	0.0135	-	-	-	-	-
S.E.			0.0218					
Inventory: Bread	-	-	-	0.0435***	-	-	-	-
S.E.				0.0114				
Inventory: Rice, pasta	-	-	-	0.0362***	-	-	-	-
S.E.				0.0126				
Inventory: Breakfast cereal	-	-	-	0.0289**	-	-	-	-
S.E.				0.0125				
Inventory: Flour	-	-	-	0.0518***	-	-	-	-
S.E.				0.0151				
Inventory: Dairy	-	-	-	-	0.0559***	-	-	-
S.E.					0.0184			
Inventory: Eggs	-	-	-	-	0.0397**	-	-	-
S.E.					0.0181			
Inventory: Fish	-	-	-	-	0.0750***	-	-	-
S.E.					0.0217			
Inventory: Non-dairy milk	-	-	-	-	-	0.0099	-	-
S.E.						0.0326		
Observations	198							
Wald χ^2 (266)	1736.81***							
Log likelihood	-401.03							

Significance is as follows: * = 10%; ** = 5%; *** = 1%.

BIBLIOGRAPHY

Allcott, Hunt and Todd Rogers (2014), "The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation," *American Economic Review*, 104 (10), 3003-37.

Aquino, Karl and Americus II Reed (2002), "The Self-Importance of Moral Identity," *Journal of Personality and Social Psychology*, 83 (6), 1423-40.

Baca-Motes, Katie, Amber Brown, Ayelet Gneezy, Elizabeth A. Keenan, and Leif D. Nelson (2013), "Commitment and Behavior Change: Evidence from the Field," *Journal of Consumer Research*, 39 (5), 1070-84.

Bajari, Patrick, Jane Cooley Fruehwirth, Kyoo il Kim, and Christopher Timmins (2012), "A Rational Expectations Approach to Hedonic Price Regressions with Time-Varying Unobserved Product Attributes: The Price of Pollution," *The American Economic Review*, 102 (5), 1898-926.

Bénabou, Roland and Jean Tirole (2011), "Identity, Morals, and Taboos: Beliefs as Assets *," *The Quarterly Journal of Economics*, 126 (2), 805-55.

Berners-Lee, Mike (2011), *How Bad Are Bananas?: The Carbon Footprint of Everything*: Greystone Books.

Blanken, Irene, Niels van de Ven, and Marcel Zeelenberg (2015), "A Meta-Analytic Review of Moral Licensing," *Personality and Social Psychology Bulletin*, 41 (4), 540-58.

Boardman, Brenda (2008), "Carbon Labelling: Too Complex or Will It Transform Our Buying?," *Significance*, 5 (4), 168-71.

Bowles, Samuel and Sandra Polania-Reyes (2012), "Economic Incentives and Social Preferences: Substitutes or Complements?," *Journal of Economic Literature*, 50 (2), 368-425.

Brännlund, Runar and Jonas Nordström (2004), "Carbon Tax Simulations Using a Household Demand Model," *European Economic Review*, 48 (1), 211-33.

Briggs, Adam D. M., Ariane Kehlbacher, Richard Tiffin, and Peter Scarborough (2016), "Simulating the Impact on Health of Internalising the Cost of Carbon in Food Prices Combined with a Tax on Sugar-Sweetened Beverages," *BMC Public Health*, 16 (1), 107.

Browning, Martin and M. Dolores Collado (2007), "Habits and Heterogeneity in Demands: A Panel Data Analysis," *Journal of Applied Econometrics*, 22 (3), 625-40.

Cascio, Jessica and E. Ashby Plant (2015), "Prospective Moral Licensing: Does Anticipating Doing Good Later Allow You to Be Bad Now?," *Journal of Experimental Social Psychology*, 56, 110-16.

Chernev, Alexander (2011), "The Dieter's Paradox," *Journal of Consumer Psychology*, 21 (2), 178-83.

Chetty, Raj, Adam Looney, and Kory Kroft (2009), "Salience and Taxation: Theory and Evidence," *American Economic Review*, 99 (4), 1145-77.

Cookson, R. (2000), "Framing Effects in Public Goods Experiments," *Experimental Economics*, 3 (1), 55-79.

Cornelissen, Gert, Mario Pandelaere, Luk Warlop, and Siegfried Dewitte (2008), "Positive Cueing: Promoting Sustainable Consumer Behavior by Cueing Common Environmental Behaviors as Environmental," *International Journal of Research in Marketing*, 25 (1), 46-55.

Daube, Marc and David Ulph (2016), "Moral Behaviour, Altruism and Environmental Policy," *Environmental and Resource Economics*, 63 (2), 505-22.

Deaton, Angus and John Muellbauer (1980), "An Almost Ideal Demand System," *The American Economic Review*, 70 (3), 312-26.

DECC (2016), "Updated Short-Term Traded Carbon Values - Used for Uk Public Policy Appraisal."

Demarque, Christophe, Laetitia Charalambides, Denis J. Hilton, and Laurent Waroquier (2015), "Nudging Sustainable Consumption: The Use of Descriptive Norms to Promote a Minority Behavior in a Realistic Online Shopping Environment," *Journal of Environmental Psychology*, 43, 166-74.

Dhar, Ravi and Itamar Simonson (1999), "Making Complementary Choices in Consumption Episodes: Highlighting Versus Balancing," *Journal of Marketing Research*, 36 (1), 29-44.

Dhar, Tirtha, Jean-Paul Chavas, and Brian W. Gould (2003), "An Empirical Assessment of Endogeneity Issues in Demand Analysis for Differentiated Products," *American Journal of Agricultural Economics*, 85 (3), 605-17.

Dickerson, Chris Ann, Ruth Thibodeau, Elliot Aronson, and Dayna Miller (1992), "Using Cognitive Dissonance to Encourage Water Conservation," *Journal of Applied Social Psychology*, 22 (11), 841-54.

Dietz, Thomas, Gerald T. Gardner, Jonathan Gilligan, Paul C. Stern, and Michael P. Vandenbergh (2009), "Household Actions Can Provide a Behavioral Wedge to Rapidly Reduce Us Carbon Emissions," *Proceedings of the National Academy of Sciences*, 106 (44), 18452-56.

Dolan, Paul, Matteo M. Galizzi, and Daniel Navarro-Martinez (2015), "Paying People to Eat or Not to Eat? Carryover Effects of Monetary Incentives on Eating Behaviour," *Social Science & Medicine*, 133, 153-58.

Dubois, Pierre, Rachel Griffith, and Aviv Nevo (2014), "Do Prices and Attributes Explain International Differences in Food Purchases?," *The American Economic Review*, 104 (3), 832-67.

Effron, Daniel A. and Paul Conway (2015), "When Virtue Leads to Villainy: Advances in Research on Moral Self-Licensing," *Current Opinion in Psychology*, 6, 32-35.

Elliott, Catherine S., Donald M. Hayward, and Sebastian Canon (1998), "Institutional Framing: Some Experimental Evidence," *Journal of Economic Behavior & Organization*, 35 (4), 455-64.

Fan, Jinqing and Irene Gijbels (1996), *Local Polynomial Regression and Its Applications*, London: Chapman and Hall.

Festinger, Leon (1962), "Cognitive Dissonance," *Scientific American*, 207 (4), 93-107.

Fishbach, Ayelet and Ravi Dhar (2005), "Goals as Excuses or Guides: The Liberating Effect of Perceived Goal Progress on Choice," *Journal of Consumer Research*, 32 (3), 370-77.

--- (2007), "Dynamics of Goal-Based Choice," in *Handbook of Consumer Psychology*, ed. Curtis P. Haugtvedt, Paul M. Herr and Frank R. Kardes, New York Routledge, 611-37.

Fishbach, Ayelet, Tal Eyal, and Stacey R. Finkelstein (2010), "How Positive and Negative Feedback Motivate Goal Pursuit," *Social and Personality Psychology Compass*, 4 (8), 517-30.

Freedman, Jonathan L. and Scott C. Fraser (1966), "Compliance without Pressure: The Foot-in-the-Door Technique," *Journal of Personality and Social Psychology*, 4 (2), 195-202.

Garnett, Tara (2011), "Where Are the Best Opportunities for Reducing Greenhouse Gas Emissions in the Food System (Including the Food Chain)?," *Food Policy*, 36, Supplement 1, S23-S32.

Gino, Francesca, Michael I. Norton, and Roberto A. Weber (2016), "Motivated Bayesians: Feeling Moral While Acting Egoistically," *The Journal of Economic Perspectives*, 30 (3), 189-212.

Gneezy, Ayelet , Alex Imas, Amber Brown, Leif D. Nelson, and Michael I. Norton (2012), "Paying to Be Nice: Consistency and Costly Prosocial Behavior," *Management Science*, 58 (1), 179-87.

Gneezy, Uri, Stephan Meier, and Pedro Rey-Biel (2011), "When and Why Incentives (Don't) Work to Modify Behavior," *The Journal of Economic Perspectives*, 25 (4), 191-209.

Greenberg, Adam Eric (2014), "On the Complementarity of Prosocial Norms: The Case of Restaurant Tipping During the Holidays," *Journal of Economic Behavior & Organization*, 97, 103-12.

Grunert, Klaus G., Sophie Hieke, and Josephine Wills (2014), "Sustainability Labels on Food Products: Consumer Motivation, Understanding and Use," *Food Policy*, 44, 177-89.

Hanemann, W. Michael (1984), "Discrete/Continuous Models of Consumer Demand," *Econometrica*, 52 (3), 541-61.

Hilton, Denis, Laetitia Charalambides, Christophe Demarque, Laurent Waroquier, and Charles Raux (2014), "A Tax Can Nudge: The Impact of an Environmentally Motivated Bonus/Malus Fiscal System on Transport Preferences," *Journal of Economic Psychology*, 42, 17-27.

Hoppert, Karin, Robert Mai, Susann Zahn, Stefan Hoffmann, and Harald Rohm (2012), "Integrating Sensory Evaluation in Adaptive Conjoint Analysis to Elaborate the Conflicting Influence of Intrinsic and Extrinsic Attributes on Food Choice," *Appetite*, 59 (3), 949-55.

Imbens, Guido W. and Whitney K. Newey (2009), "Identification and Estimation of Triangular Simultaneous Equations Models without Additivity," *Econometrica*, 77 (5), 1481-512.

Jia, Fanli, Kendall Soucie, Susan Alisat, Daniel Curtin, and Michael Pratt (2017), "Are Environmental Issues Moral Issues? Moral Identity in Relation to Protecting the Natural World," *Journal of Environmental Psychology*, 52, 104-13.

Joosten, Anne, Marius Dijke, Alain Hiel, and David Cremer (2014), "Feel Good, Do-Good!? On Consistency and Compensation in Moral Self-Regulation," *Journal of Business Ethics*, 123 (1), 71-84.

Jordan, Jennifer, Elizabeth Mullen, and J. Keith Murnighan (2011), "Striving for the Moral Self: The Effects of Recalling Past Moral Actions on Future Moral Behavior," *Personality and Social Psychology Bulletin*, 37 (5), 701-13.

Kenkel, Donald S. (2005), "Are Alcohol Tax Hikes Fully Passed through to Prices? Evidence from Alaska," *The American Economic Review*, 95 (2), 273-77.

Khan, Uzma and Ravi Dhar (2006), "Licensing Effect in Consumer Choice," *Journal of Marketing Research*, 43 (2), 259-66.

--- (2007), "Where There Is a Way, Is There a Will? The Effect of Future Choices on Self-Control," *Journal of Experimental Psychology: General*, 136 (2), 277-88.

Kirmani, Amna and Akshay R. Rao (2000), "No Pain, No Gain: A Critical Review of the Literature on Signaling Unobservable Product Quality," *Journal of Marketing*, 64 (2), 66-79.

Lahiri, Kajal and Peter Schmidt (1978), "On the Estimation of Triangular Structural Systems," *Econometrica*, 46 (5), 1217-21.

Lamberton, Cait (2013), "A Spoonful of Choice: How Allocation Increases Satisfaction with Tax Payments," *Journal of Public Policy & Marketing*, 32 (2), 223-38.

Laran, Juliano and Chris Janiszewski (2009), "Behavioral Consistency and Inconsistency in the Resolution of Goal Conflict," *Journal of Consumer Research*, 35 (6), 967-84.

Larcom, Shaun , Luca A Panzone, and Timothy Swanson (2017), "Follow-the-Leader? Measuring the Internalisation of Law," in *CIES Research Paper series*, Geneva: The Graduate Institute of International and Development Studies.

Liberman, Varda, Steven M. Samuels, and Lee Ross (2004), "The Name of the Game: Predictive Power of Reputations Versus Situational Labels in Determining Prisoner's Dilemma Game Moves," *Personality and Social Psychology Bulletin*, 30 (9), 1175-85.

Manchanda, Puneet, Asim Ansari, and Sunil Gupta (1999), "The "Shopping Basket": A Model for Multicategory Purchase Incidence Decisions," *Marketing Science*, 18 (2), 95-114.

Mazar, Nina and Chen-Bo Zhong (2010), "Do Green Products Make Us Better People?," *Psychological Science*.

McAdams, Richard H. (1997), "The Origin, Development, and Regulation of Norms," *Michigan Law Review*, 96 (2), 338-433.

McMichael, Anthony J., John W. Powles, Colin D. Butler, and Ricardo Uauy (2007), "Food, Livestock Production, Energy, Climate Change, and Health," *The Lancet*, 370 (9594), 1253-63.

Metcalf, Gillbert E. and David Weisbach (2009), "The Design of a Carbon Tax," *Harvard Environmental Law Review*, 33, 499-556.

Milkman, Katherine L. and John Beshears (2009), "Mental Accounting and Small Windfalls: Evidence from an Online Grocer," *Journal of Economic Behavior & Organization*, 71 (2), 384-94.

Miller, Dale T. and Daniel A. Effron (2010), "Chapter Three - Psychological License: When It Is Needed and How It Functions," in *Advances in Experimental Social Psychology*, Vol. Volume 43, ed. P. Zanna Mark and M. Olson James: Academic Press, 115-55.

Monin, Benoît and Alexander H Jordan (2009), "The Dynamic Moral Self: A Social Psychological Perspective," in *Personality, Identity, and Character: Explorations in Moral Psychology*, ed. Darcia Narvaez and Daniel K. Lapsley, New York (USA): Cambridge University Press, 341-54.

Mukhopadhyay, Anirban, Jaideep Sengupta, and Suresh Ramanathan (2008), "Recalling Past Temptations: An Information-Processing Perspective on the Dynamics of Self-Control," *Journal of Consumer Research*, 35 (4), 586-99.

Mullen, Elizabeth and Benoît Monin (2016), "Consistency Versus Licensing Effects of Past Moral Behavior," *Annual Review of Psychology*, 67 (1), 363-85.

Nair, Harikesh, Jean-Pierre Dubé, and Pradeep Chintagunta (2005), "Accounting for Primary and Secondary Demand Effects with Aggregate Data," *Marketing Science*, 24 (3), 444-60.

Nauges, Céline and Sarah Ann Wheeler (2017), "The Complex Relationship between Households' Climate Change Concerns and Their Water and Energy Mitigation Behaviour," *Ecological Economics*, 141, 87-94.

Nikolova, Hristina, Cait Lamberton, and Kelly L. Haws (2016), "Haunts or Helps from the Past: Understanding the Effect of Recall on Current Self-Control," *Journal of Consumer Psychology*, 26 (2), 245-56.

Panzone, L. A., A. Wossink, and D. Southerton (2013), "The Design of an Environmental Index of Sustainable Food Consumption: A Pilot Study Using Supermarket Data," *Ecological Economics*, 94, 44-55.

Panzone, Luca A. (2012), "Alcohol Tax, Price–Quality Proxy and Discounting: A Reason Why Alcohol Taxes May Rebound," *Journal of Agricultural Economics*, 63 (3), 715-36.

Panzone, Luca, Denis Hilton, Laura Sale, and Doron Cohen (2016), "Socio-Demographics, Implicit Attitudes, Explicit Attitudes, and Sustainable Consumption in Supermarket Shopping," *Journal of Economic Psychology*, 55, 77-95.

Papoutsi, Georgia S., Rodolfo M. Nayga Jr, Panagiotis Lazaridis, and Andreas C. Drichoutis (2015), "Fat Tax, Subsidy or Both? The Role of Information and Children's Pester Power in Food Choice," *Journal of Economic Behavior & Organization*, 117, 196-208.

Pearce, David (1991), "The Role of Carbon Taxes in Adjusting to Global Warming," *The Economic Journal*, 101 (407), 938-48.
Perino, Grischa, Luca A. Panzone, and Timothy Swanson (2014), "Motivation Crowding in Real Consumption Decisions: Who Is Messing with My Groceries?," *Economic Inquiry*, 52 (2), 592-607.
Prucha, Ingmar (1987), "The Variance-Covariance Matrix of the Maximum Likelihood Estimator in Triangular Structural Systems," *Econometrica*, 55 (4), 977-78.
Raghunathan, Rajagopal , Rebecca Walker Naylor, and Wayne D. Hoyer (2006), "The Unhealthy = Tasty Intuition and Its Effects on Taste Inferences, Enjoyment, and Choice of Food Products," *Journal of Marketing*, 70 (4), 170-84.
Rode, Julian, Erik Gómez-Baggethun, and Torsten Krause (2015), "Motivation Crowding by Economic Incentives in Conservation Policy: A Review of the Empirical Evidence," *Ecological Economics*, 117, 270-82.
Sachdeva, Sonya, Rumen Iliev, and Douglas L. Medin (2009), "Sinning Saints and Saintly Sinners: The Paradox of Moral Self-Regulation," *Psychological Science*, 20 (4), 523-28.
Stöber, Joachim (2001), "The Social Desirability Scale-17 (Sds-17): Convergent Validity, Discriminant Validity, and Relationship with Age," *European Journal of Psychological Assessment*, 17 (3), 222-32.
Sunstein, Cass R and Lucia A Reisch (2014), "Automatically Green: Behavioral Economics and Environmental Protection," *Harvard Environmental Law Review*, 38 (1), 127-58.
Sussman, Abigail B. and Christopher Y. Olivola (2011), "Axe the Tax: Taxes Are Disliked More Than Equivalent Costs," *Journal of Marketing Research*, 48 (SPL), S91-S101.
Tiefenbeck, Verena, Thorsten Staake, Kurt Roth, and Olga Sachs (2013), "For Better or for Worse? Empirical Evidence of Moral Licensing in a Behavioral Energy Conservation Campaign," *Energy Policy*, 57, 160-71.
Ulph, Alistair, Luca A. Panzone, and Denis Hilton (2018), "A Dynamic Self-Regulation Model of Sustainable Consumer Behaviour.," in *Social Science Research Network (SSRN)*.
Vandenbergh, Michael P and Anne C Steinemann (2007), "The Carbon-Neutral Individual," *New York University Law Review*, 82, 1673-745.
Warde, Alan (2014), "After Taste: Culture, Consumption and Theories of Practice," *Journal of Consumer Culture*, 14 (3), 279-303.
Zauberman, Gal, B. Kyu Kim, Selin A. Malkoc, and James R. Bettman (2009), "Discounting Time and Time Discounting: Subjective Time Perception and Intertemporal Preferences," *Journal of Marketing Research*, 46 (4), 543-56.
Zhong, Chen-Bo, Katie A Liljenquist, and Daylian M Cain (2009), "Moral Self-Regulation," in *Psychological Perspectives on Ethical Behavior and Decision Making*, ed. David De Cremer, Charlotte, NC: Information Age Publishing, INC., 75-89.
Zizzo, Daniel, Melanie Parravano, Ryota Nakamura, Suzanna Forwood, and Marc Eckart Suhrcke (2016), *The Impact of Taxation and Signposting on Diet: An Online Field Study with Breakfast Cereals and Soft Drinks*.
Zuckerman, Miron, Michele M. Iazzaro, and Diane Waldgeir (1979), "Undermining Effects of the Foot-in-the-Door Technique with Extrinsic Rewards," *Journal of Applied Social Psychology*, 9 (3), 292-96.

THE IMPACT OF ENVIRONMENTAL RECALL AND CARBON TAXATION ON THE CARBON FOOTPRINT OF SUPERMARKET SHOPPING

ONLINE APPENDICES

APPENDIX 1. EXPERIMENTAL INSTRUCTIONS

Thank you for your participation to this research. With your answers we are trying to understand what drives consumer choices, and how these factors determine what consumers buy during a grocery shopping trip. All the information you give us will be completely confidential: we will give you an anonymous ID code, and no one (including the investigator) will know the information in the data belongs to you. The data will be subject to statistical analysis and will be stored indefinitely in a safe repository inaccessible to anyone outside the research team.

In this research, you will be assigned a virtual weekly budget of £25 to spend on grocery shopping online. You can spend as much of this in our virtual shop as you wish. It is important that you make choices as you would in any shopping trip you make. At the end of the two weeks, we will select randomly one of your two baskets: you will actually receive the goods you ordered and placed in this basket, and receive in cash the balance of the £25 not spent in the chosen week. Please notice that while we source our products from Tesco stores, Tesco has no involvement in this research.

In addition, every participant will receive £5 as recognition of the time spent in taking part in this research. This money, which is guaranteed to you, is independent on what you purchase or the answers you give. **You will receive the £5 when you collect your basket.**

After completion of the experiment, you will also be able to withdraw within six weeks of your last visit by contacting Dr Luca Panzone, School of Agricultural, Food and Rural Development,

Newcastle University, phone: 0191 2083594, e-mail: l.a.panzone@newcastle.ac.uk and quoting your ID code.

CONSENT FORM

Please tick all in order to proceed. You can ask for details of points you do not wish to tick to the Research Assistant.

I have read and understood the information in the Information Sheet.	○
I have been given the opportunity to ask questions about the project and my participation.	○
I understand that in compensation for my time I will receive £5 for 2 weeks of survey. I will receive this money at the end of the second survey.	○
I understand that I will be given a notional £25 budget each week and asked to make purchases in the online shop; I can spend as much or as little as I choose provided it is within the £25 budget.	○
I understand that I will receive one of my two chosen basket of goods and the money I have not spent in the same week, in which case I will accept the items I purchased.	○
I understand that all the anonymised information deriving from the experiments will be completely confidential and the data will be stored indefinitely in a safe repository of Newcastle University.	○
I understand that I can withdraw at any point during this research, including after completion by contacting Luca Panzone within 6 weeks of my last visit.	○
I understand that the anonymised data will be used for publication of the outcomes of this research, and I agree that the data can be used in this way.	○

We take your decision to answer the questions to be an acknowledgement that you have had the terms of your participation adequately explained and that you give your consent. For further information, you are welcome to contact Dr Luca Panzone at any time using the contact details indicated above.

I accept the terms and conditions (Yes/No)

Environmental recall questionnaire (when applicable)

Please pause one moment and think about the activities you have done in the past week (i.e. the past 7 days) to help protect the natural environment for you and for others. How often have you done any of these during the last week? (randomised order)

Act/Frequency	**Please specify the number of occasions:**	**Never**
Eaten a standard 10g portion of margarine rather than the same amount of butter	_____times	○
Used my own bag for shopping instead of using a plastic bag supplied by the retailer when shopping	_____times	○
Did not waste any of the food on my plate when eating in a meal.	_____times	○
Eaten 100g of meat substitutes rather than 100g of beef ***100g of meat equals to:*** *a 5oz rump steak; just over a portion of Sunday roast (three thin-cut slices of roast = 90g); or a bit more than one quarter-pounder beefburger (= 78g).*	_____times	○
Took a shorter (2-minute) shower than the UK average (8-minute)	_____times	○
Walked rather than driven to go to University	_____times	○
Cycled rather than driven to go to University	_____times	○
Walked rather than took public transport to go to University	_____times	○
Cycled rather than took public transport to go to University	_____times	○
Washed clothing at 30 degrees rather than 60 degrees	_____times	○
Turned off your laptop completely rather than leaving it on standby	_____times	○
Turned off your TV completely rather than leaving it on standby	_____times	○
Turned off the tap when brushing teeth	_____times	○

Recycled one aluminium can	_____times	○
Put an old newspaper in the recycling bin instead of the garbage bin	_____times	○
Put an old magazine in the recycling bin instead of the garbage bin	_____times	○
Recycled the equivalent of one 750-ml glass bottle (this is the typical size of a wine bottle)	_____times	○
Recycled the equivalent of one 500-ml glass bottle (this is the typical size of a one-pint beer or milk bottle)	_____times	○
Recycled the equivalent of one 330-ml glass bottle (this is the typical size of a small beer bottle)	_____times	○
Recycled one plastic bottles	_____times	○
I turned off unnecessary lights in my home (enter number of days)	_____times	○

Please indicate the distance between your house and the University: _____

If over the past week you have done any other actions not in the table above that involved effort and time to help protect the environment, please use the box below to give a short description of these actions, indicating the amount of time (in minutes) you dedicated to them.

Over the past week by carrying out these acts you have saved [VALUE TO BE DISPLAYED] grams of carbon footprint.

Moral self-image scale (Jordan, Leliveld, and Tenbrunsel, 2011)

Compared to the environmentally-friendly person I want to be, I am:

1	2	3	4	5	6	7	8	9
Much less environmentally friendly than the person I want to be				*Exactly as environmentally friendly as the person I want to be*				*Much more environmentally friendly than the person I want to be*

SUPERMARKET SHOPPING

[ADDITIONAL INFORMATION FOR THOSE FACING A TAX ONLY – PRESENTED JUST BEFORE ENTERING THE STORE]

In this store, all prices have been increased with a carbon tax that reflects the carbon footprint of each product. The carbon footprint is the amount of greenhouse gases emitted in the production and sale of each of the products in stock, and the size of the carbon tax varies across products to reflect differences in carbon footprint. The tax rate we have imposed is £70 per tonne of carbon emissions, in line with the estimated long-term costs of climate change published by the UK Department of Energy & Climate Change. The price in the store includes the tax, but you will see the tax charged on each product.

Importantly, the total revenues raised from the carbon tax (i.e. from all participants) will be shared equally between all taxpayers: everyone in this treatment (including you) will receive back exactly the same amount of tax revenue at the end of the experiment.

CHECK OUT OF SHOPPING TRIP

Inventory:

How much of the following food do you currently have in your home?

	I never buy this product	I am currently running low	I currently I have enough
Pulses	○	○	○
Bottled Water, Fruit Juice, and Soft Drinks	○	○	○
Oil, margarine, and butter	○	○	○
Cheese, milk, and other dairy products	○	○	○
Fish	○	○	○
Bread and bakery products	○	○	○
Meat	○	○	○
Vegetables (fresh, frozen, and canned)	○	○	○
Fruit	○	○	○
Rice and Pasta	○	○	○
Breakfast Cereal	○	○	○
Eggs	○	○	○
Non-Dairy Milk	○	○	○
Salt, Sugar	○	○	○
Tea, Coffee	○	○	○
Sauces (e.g. mustard, ketchup)	○	○	○
Honey and Jam	○	○	○
Flour	○	○	○

Willingness to Pay Question

Suppose you consume 1000 KWh or electricity bill a year. This amount of energy costs you £ 120/year, and generates 500kg of carbon emissions. You receive a leaflet from another

electricity supplier of comparable quality who can give you the same electricity, but generated from more renewable sources than your current supplier. Changing to this new supplier would reduce the carbon generated by your 1000 KWh electricity consumption by 20%; so by switching you would save 100kg of carbon without reducing your electricity use.

However, this change will increase the cost of your initial bill. How much more would you be willing to pay on top of the £120 a year you currently pay for electricity to reduce the carbon footprint of your electricity consumption by 100kg?

£ _____

Self-control (Zauberman et al. 2009)

Imagine receiving a gift certificate worth £50, valid from today. How much would you need to be paid to wait before using the gift certificate for:

- 1 year: _____

Pro-environmental Attitudes (Cornelissen et al. 2008) (1=very negative, 7=very positive)

- How do you feel about environmental behaviours?
- How do you feel about performing environmental behaviours?
- How important is it that you perform environmental behaviours?

Self-perception scale (Cornelissen et al. 2008) (1=totally don't agree, 7=totally agree)

- I think my behaviour is environmentally responsible
- When I buy a product, I take environmental considerations into account.

Moral obligation scale (Cornelissen et al. 2008) (1=totally don't agree, 7=totally agree)

- I feel morally obliged to protect the environment

Moral identity (Aquino and Reed, 2002) (1=totally don't agree, 7=totally agree)

1. Caring for the environment is an important part of who I am.
2. I often buy products that communicate the fact that I care for the environment
3. The types of things I do in my spare time (e.g., hobbies) clearly identify me as caring for the environment.
4. The kinds of books and magazines that I read identify me as caring for the environment.
5. I am actively involved in activities that communicate to others that I care for the environment.
6. It would make me feel good to be a person who cares for the environment.
7. A big part of my emotional well-being is tied up in caring for the environment.
8. I would be ashamed to be a person who cares for the environment. (R)
9. Caring for the environment is not really important to me. (R)
10. Caring for the environment is an important part of my sense of self.
11. I strongly desire to care for the environment.
12. I often wear clothes that identify me as caring for the environment.
13. The fact that I care for the environment is communicated to others by my membership in certain organizations.

Social Desirability Scale (short version) (Stöber 2001)

Please read each statement carefully and decide if that statement describes you or not. If it describes you, check the word "true"; if not, check the word "false".

	True	False
I sometimes litter.	○	○
I always admit my mistakes openly and face the potential negative consequences.	○	○
In traffic I am always polite and considerate of others.	○	○
I have tried illegal drugs (for example, marijuana, cocaine, etc.).	○	○
I always accept others' opinions, even when they don't agree with my own.	○	○
I take out my bad moods on others now and then.	○	○
There has been an occasion when I took advantage of someone else.	○	○
In conversations I always listen attentively and let others finish their sentences.	○	○
I never hesitate to help someone in case of emergency.	○	○
When I have made a promise, I keep it--no ifs, ands or buts.	○	○
I occasionally speak badly of others behind their back.	○	○
I would never live off other people.	○	○
I always stay friendly and courteous with other people, even when I am stressed out.	○	○
During arguments I always stay objective and matter-of-fact.	○	○
There has been at least one occasion when I failed to return an item that I borrowed.	○	○
I always eat a healthy diet.	○	○
Sometimes I only help because I expect something in return.	○	○

Environmental Literacy *(objectives: 1) to test if people pay more attention to footprint; 2) to test if people have prior knowledge of carbon footprint)*

- Which of these products do you think is **higher** in carbon footprint? (also in store)

(2 litres of Cola in 1 plastic bottle; 2 litres of Cola in six 330-ml cans; Both the same; Not sure/Don't know).

- Which of these products do you think is **higher** in carbon footprint? (also in store)

  (A pack of 6 own-labelled organic eggs; a pack of 6 own-labelled free-range eggs; Both the same; Not sure/Don't know).

- Which of these products do you think is **higher** in carbon footprint? (also in store)

  (A pint of whole milk; A pint of skimmed milk; both the same; Not sure/Don't know)

- Which of these products do you think is **higher** in carbon footprint? (also in store)

  (1 litre of Orange Juice not-from-concentrate; 1 litre of Orange Juice from-concentrate; both the same; Not sure/Don't know)

- Which of these products do you think is **higher** in carbon footprint? (not in store)

  (A 500g portion of Chicken Biryani; A 500g portion of Shepherd's Pie; both the same; Not sure/Don't know)

- Which of these products do you think is **higher** in carbon footprint? (not in store)

  (One Thin Crust Cheese Feast Pizza; One Thin Crust Pepperoni Pizza; Both the same; Not sure/Don't know)

- Which of these products do you think is **higher** in carbon footprint? (not in store)

  (1 litre of lager beer in two 500ml cans; 1 litre of lager beer in four 250ml bottles; both the same; Not sure/Don't know)

- Which of these products do you think is **higher** in carbon footprint? (not in store)

(A standard 250-ml cup of latte; A standard 250-ml cup of cappuccino; Both the same; Not sure/Don’t know)

You are:

☐ Male ☐ Female

Your age group:

☐ 18-25

☐ 26-35

☐ 36-45

☐ 46-55

☐ More than 55

Your nationality: _____

Year of Study

☐ Year 1

☐ Year 2

☐ Year 3

☐ Master course

☐ PhD

Faculty of Study

☐ Science, Agriculture, and Engineering

☐ Humanities and Social Science

☐ Medical Science

How would you describe your ethnicity?

☐ White

☐ Mixed

☐ Asian or Asian British

☐ Black or Black British

☐ Chinese or other ethnic group

☐ Others – please specify: _____

What is your religion?

☐ Christian

☐ Jewish

☐ Muslim

☐ Hindu

☐ Buddhist

☐ None (atheist or agnostic)

☐ Others – please specify: _____

What political party do you support or identify with?

☐ Conservative Party

☐ Labour Party

☐ Green Party

☐ Liberal Democrats

☐ Others – please specify: _____

Membership of an environmental association

Are you a member of an environmental association (e.g. Friends of the Earth, WWF)? If yes, please specify: _____